ENVIRONMENTAL ASSESSMENT BOARD

Ontario

ONTARIO HYDRO DEMAND/SUPPLY PLAN HEARINGS

VOLUME: 117

DATE: Tuesday, March 3, 1992

BEFORE:

HON. MR. JUSTICE E. SAUNDERS	Chairman
DR. G. CONNELL	Member
MS. G. PATTERSON	Member

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EA-90-01

ENVIRONMENTAL ASSESSMENT BOARD
ONTARIO HYDRO DEMAND/SUPPLY PLAN HEARING

IN THE MATTER OF the Environmental Assessment Act, R.S.O. 1980, c. 140, as amended, and Regulations thereunder;

AND IN THE MATTER OF an undertaking by Ontario Hydro consisting of a program in respect of activities associated with meeting future electricity requirements in Ontario.

Held on the 5th Floor, 2200 Yonge Street, Toronto, Ontario, on Tuesday, the 3rd day of March, 1992, commencing at 10:00 a.m.

VOLUME 117

B E F O R E :

THE HON. MR. JUSTICE E. SAUNDERS	Chairman
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MS. G. PATTERSON	Member

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R. CUYLER		ON HIS OWN BEHALF

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L I S T of U N D E R T A K I N G S

TIME NOTATIONS

---Upon commencing at 10:04 a.m.

THE REGISTRAR: Please come to order. This hearing is now in session. Be seated, please.

THE CHAIRMAN: Mr. Grenville-Wood?

MR. GRENVILLE-WOOD: Good morning, Mr. Chairman, Members of the Panel.

WALTER RAYMOND EFFER,
CHARLES WILLIAM DAWSON,
JAMES RICHARD BURPEE,
GARY NEIL MEEHAN,
JOHN DOUGLAS SMITH,
AMIR SHALABY; Resumed.

CROSS-EXAMINATION BY MR. GRENVILLE-WOOD:

Q. Mr. Shalaby, I guess you probably were expecting me to ask the first question to you.

Well, we have heard you yea these many days, weeks and months, and I guess we can fairly conclude, can we not, that you are a friend of renewable energy? I think that is a fair statement, isn't it?

MR. SHALABY: A. I'm proud for the Solar Society to reach that conclusion. That is not the way you portrayed me in your magazine, but I am glad you are changing your opinion now.

Q. Well, you know, the road to Damascus is fraught with many turnings.

But in any event, in the context of the

alternative energy review at page 39, paragraph 1-12.11, you identified a number of barriers to large scale implementation of photovoltaic technology. It is at page 39, again.

A. 1-12?

Q. Sorry?

A. 1-12, is it?

Q. 1-12.11.

A. Right.

Q. You identify three of them here: high capital cost, high intermittent availability of power, and limited manufacturing capacity at best.

Now, as a friend of renewable energy how would you suggest that these barriers could be overcome? Maybe first I could ask you, how would you suggest that Hydro could deal with the question of the high initial capital cost?

A. I don't think that is an issue for Hydro to deal with. It is not within Hydro's -- despite all its might, as some of the Intervenors suggest all the time, that if Hydro intervenes things will work out.

It is not, in my opinion, any one company's ability to change that market from an expensive manufacturing and processing of that product

to an inexpensive and cheap product. It is just an expensive product to make in photovoltaics.

My belief is that it will take time for scientific work to take place, and manufacturing perfections to take place, and commercialization elsewhere in the world to take place, before the product becomes more commercially viable in various market niches.

So the short answer is, I don't think Hydro alone can do anything to make that product economic in a short period of time.

Q. Okay. Well, you said "not Hydro alone". The point, I guess, is do you see Hydro playing a role in overcoming that particular barrier? I mean, are you saying that we should leave the whole issue of capital costs of some of these technologies, and specifically PV, to the market, or is there some useful role that you could foresee after having done this review and identified these barriers, a useful role that Hydro could play?

A. I think in the area of costs it is largely going to be the market, and the manufacturers, and the researchers.

We play a small role in research, a small role in demonstrating and testing these facilities, a

small role as a buyer of some of this equipment.

Mind you, I say "small", but we are operating the largest photovoltaic facility in Canada. We are working with the Sunnybrook Hospital to put one that is even larger still, a 100 kilowatt facility, which is about ten times the Big Trout Lake facility.

But even then, in the scale of photovoltaics worldwide that is small activity. It is the largest in Canada, but it is still small on the scale of moving the technology from where it is to where it will be in ten years.

Q. Do you see the usefulness of a change in the policy framework to address this kind of question, or do you rely totally on the market in this kind of situation?

A. Usefulness for what purpose?

Q. Well, to overcome the barrier. I mean, we have identified -- at least, you have identified that the initial capital cost is a barrier, and you have indicated that you are playing a small role through demonstration projects, and so on.

A. Yes.

Q. I am asking you whether there is in your estimation a role for a difference or a change in the policy framework under which you operate and under

which we all operate in the province.

A. A change in policy that would help --

THE CHAIRMAN: I'm sorry, do you mean policy, government policy or Hydro policy?

MR. GRENVILLE-WOOD: Q. No, I mean government policy.

MR. SHALABY: A. I am not sure that is my domain to speak to, but, of course, government policies can and do change the way different technologies find their way into application.

Q. All right. What about now the second barrier you have identified, which is what you call the intermittent availability of power. First, what exactly did you mean by that phrase, "intermittent availability of power"?

A. I mean that it is not available all the time. It is available, say, 20 per cent of the time, during daylight hours mostly, mostly in the summertime, and even then when cloud cover is extensive, and so on, the power is not available.

Q. I see. So now, are you applying that barrier across the board to the technology, or do you see it as a barrier that applies to larger as opposed to smaller scale use of the technology?

A. No, it is a feature of using the

resource. It is really a barrier because of the technology. The resource is not available all the time. That is really a statement that says that resource is not available around the clock. Electricity demand is around the clock to various degrees, up and down, but that resource can only supply demand at various times and specific times.

Q. Would you not agree that in particular applications, though, that isn't necessarily a barrier?

A. That's right.

Q. If you have a limited scope of application that is designed to meet--

A. That is right.

Q. --the requirements of the technology, then that isn't a problem?

A. That is correct. Examples would be air conditioning, that could -- refrigeration, air conditioning are technologies -- or the applications that have demand that peaks during the hot daylight hours, and perhaps that technology is a good match for it, and we have mentioned that.

And that barrier is surmountable in a way; that is, by storage, by working together with other components in the system that is surmountable

barrier. It is a barrier, but it is not one that is as difficult to overcome as initial capital cost.

Q. Is there something that is related to the climate as well in your conclusion; in other words, the particular climate of Ontario?

A. We indicated that the solar resource is very much correlated to the latitude, so yes. A province that is in the northern hemisphere receives less sunshine than Arizona and California.

Q. That brings me to the map which is on page 16 of the review. I think it is figure 1-2-1.

Would you say this is an accurate representation of the solar radiation situation in North America?

A. Yes.

Q. Is it not correct to say that this is a look at the flat representation of the continent?

A. The definition of solar radiation measured in megajoule per metre squared by definition is on a flat surface.

Q. Now, --

A. That is sort of the scientific measurement definition for it.

Q. I understand. I understand that.

Well, wouldn't you think that there would

be some distortion as a result of the fact that you can, for example, angle arrays to take greater advantage of the sun when you are at more northern latitudes, or even more southern latitudes, I suppose, from the equator?

A. That doesn't make the map invalid. It just says that on a flat surface you are getting so many megajoules per metre squared. If you put an inclined surface you may capture more. But I agree --

Q. But you would agree that if you had an inclined surface you would capture more than was necessarily represented by the map?

A. I think so, yes. Now, I don't think significantly more. I don't know how much more, but...

Q. Have you done any examination of that --

A. I don't know myself, no.

Q. And, of course, the distinction between a more northern latitude as opposed to a southern one--

Like, I think you use Toronto and Phoenix, as examples?

A. Yes.

Q. --may be sharpened because of the -- your comparison is between Phoenix and Toronto and a

couple of these --

A. Yes.

Q. So because of the angle difference you may have quite a distinctive difference; do you not agree with that?

A. We are showing a distinct difference between the two. Is that what you are referring to?

Q. Yes. And would the difference be less or more if you adjusted for the angle of the array?

A. I don't know that. I don't know. I don't know whether Phoenix as well, by tracking and angling, can capture more. I don't know.

[10:15 a.m.]

Q. Now, the third barrier you identify, again going back to page 39, is limited manufacturing capacity.

A. And it treats limited manufacturing at present.

Q. At present?

A. Right.

Q. Now again, the question I am posing to you is: In your estimation is there a role for Hydro to play in overcoming this barrier?

A. Well, I think if we feel that our

intervention - and that's the evidence that I have given to Mr. Cuyler as well - if Hydro feels that its intervention is in the best customers and can make a difference in the marketplace I think we will consider it.

Our judgment now is that our intervention (A) is not providing an option that lowers total customer cost, and (B) is not likely to make a significant difference in the market, unless it's a massive entry into the market, but that's not something we are contemplating.

Q. Again, is there any more generalized impact from others than Hydro that you could foresee having an impact on this barrier?

A. Impact?

Q. On the barrier.

A. Well, I think this is the sort of chicken and egg type of idea. If the cost is low there will be more applications, more people buying the product and more people would invest in manufacturing capability.

It's not a fixed, insurmountable barrier. Manufacturing capability is put in place when the product has a market. So I think this is really something that trails the market, if people expect the

market to materialize they will put manufacturing capability in place.

Q. So effectively, if Hydro or a major more player, I suppose it could be the government decided to intervene in the market to create a demand, that would have a direct impact on this particular barrier?

A. I would think so.

Q. Now, as you know there are a number of other barriers that have been identified as standing in the way of greater acceptability and acceptance of renewable technologies. For example, would you agree that there is relatively limited knowledge of technologies such as solar?

A. Limited as compared to knowledge of other technologies or...

Q. Yes, I think that's a good way of putting it, yes.

A. I think there is a great enthusiasm about solar technologies by certain people that have a great amount of knowledge about it, other people don't have as much knowledge.

Q. Take an example of the people at Hydro who are obviously highly trained and skilled, generally speaking, across the board. Have you done

any studies internally in terms of preparing for this series of hearings to see what is the generalized knowledge of Hydro staff about renewable technologies?

A. We haven't done a study like that, no.

Q. What would be your intuitive guess as to their level of knowledge on a comparative basis with the regular technologies that Hydro has been using to produce energy?

A. I would think a large number of Hydro people have sufficient knowledge and curiosity about solar technologies.

We have a large number of articles, for example, published in the what we call Hydro Scope, the company newspaper, on solar projects, Big Trout Like and Dog Lake Project, international projects that some of our experts do in Kenya and elsewhere on photovoltaics, that capture the imagination and the interests of a lot of Hydro people.

So to know whether they know anymore about solar than they do about IGCC, I have no idea. A lot of people don't know a lot about IGCC either.

But I think solar is a technology that captures the imagination and sparks the interests of a lot of engineers inside.

Q. Would you say that there is a gap in the knowledge between what people who know something about it or something about the whole energy sector generally, and the general public? Is there a gap in that knowledge? Is there something that could be done to overcome the barrier of limited knowledge?

A. A gap between the general public's knowledge of solar and --

Q. Let me give you a more specific example. Maybe I am being a little too general.

From time to time Hydro puts out information packages in your Hydro bill and so on about showerheads or compact fluorescence, or something like that, and not only does it encourage people to use the technology or the option, but they also transmit basic fundamental information.

Has Hydro ever considered doing something like that about some of the solar technology?

A. Hydro has and is in fact is a source of solar energy information to a very large number of customers and people who inquire about solar energy.

We receive literally hundreds of inquiries every year from students who are doing projects to farmers and homeowners who want to be independent and put some solar energy on their farms

and houses, and we have developed a kit actually, or information package, that we send out to people who make that kind of inquiry. It's available in our public reference centre, in our library and so on.

Q. Have you made a generalized sort of insert to people's Hydro's bills about these things?

A. It's not Ontario Hydro's authority to go into billing envelopes. It's a municipal, generally a municipal utility --

Q. Isn't that a cooperative program, that when you decide to do something of this nature, that you enter into agreements to distribute this kind of information?

A. We have not done it for photovoltaics.

Q. No.

A. I am not sure we have done it for anything else either. Maybe we have but I am aware of it.

I know it's a big deal to get into the envelopes of municipal utilities.

Q. You have conducted, and I have read in the paper today that is there is going to be a new program announced on demand management, announced in the Globe and Mail this morning. It wasn't announced

there, it was reported there. I noticed there was no reference to any solar technologies in that program, at least not in the Globe and Mail article. But there have been in the past and presumably in the future advertising campaigns and general information campaigns, not necessarily through the billing process but using other media. Is that one thing that Hydro could consider doing in terms of solar technologies?

A. It could, but again, the motivation has to start with: Do we think that's a product that is ready for the marketplace and is in the best interests of our customers from the sense of total customer cost.

We have screens, as we described earlier, that we put our programs through and once they pass that then we get to the question of advertising and announcements and things of that nature.

But our estimates of cost that we presented in Exhibit 344 do not give us the signal that that product is now something that will lower total customer cost. For that reason it's not entering into the package of programs we are promoting to our customers in general.

We have customers that want to it as hobbyists or as enthusiasts, or putting a premium on

independence. People want to do things for different reasons, if they show chose to do our staff is ready to help and provides a lot of assistance.

I think the demonstrations, for example, at the Kortright Centre is something that we put forth for the public to come and see firsthand how these facilities operate, how they look. We demonstrate both in our own territory of service in the remote communities and places like Kortright, Ontario Place, Sciences Centre, places like that.

Q. I guess the big gap at the moment from what you are saying is in the generalized home use, and you are saying that the great barrier at least in terms of a threshold is your analysis of the total customer cost?

A. It's not solely our analysis, but yes. Other people agree that the cost today is high, yes.

Q. Now, you have stated to the Board in earlier testimony, I am sure everyone recalls, and I think you have in a way repeated it this morning, that economies of scale would have a major impact.

A. Yes, they do.

Q. And mass production obviously.

Again, the question that comes to mind

is: Where is the impetus going to come from to achieve those economies of scale? Because, I mean, we are, as you said yourself, in a chicken and egg situation. In one situation you have got a high cost that prevents the economies of scale and the failure to have the economies of scale create the high cost.

A. Yes.

Q. So how do we insert ourselves into the situation that assuming that we want to advance this technology because of its environmental benefits, let's say, and its demand management potential and its generating potential, where do we insert policy, either Hydro or government or otherwise, to achieve some kind of a breakthrough on this issue of the economies of scale or mass production?

[10:25 a.m.]

A. Well, one of the issues that I think is not settled yet is - and different organizations are betting on different horses at this time - is: What photovoltaic technology?

As you well know, it is not a singular technology, or a singular set of materials, or a singular manufacturing process. There is not yet an emerging winner in that technology, although different people believe in different winners.

Some are easy to manufacture, but they are lower in efficiency. Some are more difficult to manufacture, but they are higher in material costs and higher in manufacturing costs, but higher efficiency. Others have properties to do with not degrading with time or reliability, but again, they are higher in cost.

So I think that market is still in the phase of settling down into what exactly is the manufacturing process and the set of materials and the type of cell that really would find wide application.

When one reads the scientific literature on photovoltaics you will find great debates going on as to whether this type or that type will, in fact, make it as the dominant type.

So I don't know whether a massive push now to sponsor a particular technology is risky or not. I think policy people in different countries and different manufacturing concerns are developing various options and letting the scientific testing and the breakthroughs take place, and when a winner emerges I think that may be a more appropriate time for policy initiatives to take place.

What I am saying here is that you may have all the policy intentions in the world, but you

don't know what horse to bet on at this time.

Q. Is Hydro doing any testing of its own on which horse to bet on?

A. Hydro is following the various developments and has joined with the University of Toronto to do some specific research about photovoltaic materials and processes. But we are not in a position to encourage manufacturing of photovoltaics to any wide scale, so I don't think we are in that position.

Q. You are not in that position, why? I mean, you just sort of threw that --

A. Well, because all the options are expensive at this time, and we feel it is better off left to the manufacturers and the research organizations that are working on these photovoltaics for the winners to emerge and the viability to be established.

These are multi-national programs at this stage; it is not any utility or not even any single country. The Europeans are putting effort together, Italy and Germany and elsewhere. The Japanese are putting effort together. The United States used to be a leader in the manufacturing and research of photovoltaics. It is slipping away now, and they are wanting to regain that position of dominance.

So it is national program in different countries and different groups of countries that really is taking the lead in research in photovoltaics.

Q. But on that list Canada doesn't appear, and Ontario doesn't appear, and Hydro doesn't appear?

A. They appear as part of consortiums, again very similar to the effort I described in fuel cells and wind.

Q. But very small scale?

A. It is a small scale, yes.

Q. Now, that leads me to a question about research and development and the whole question of how much is in fact going on in this field in Hydro.

Would you agree that there is, at least in the Canadian context, insufficient research and development on solar technologies?

A. I don't know whether I am in a position to say what is sufficient or what is insufficient. There is always competition for research and development funds between different programs. Advocates of various programs always believe that they are underfunded. So I think it is a subjective judgment.

Q. Maybe I could ask you a specific

question. How much is Hydro spending on research and development? On renewable technologies first. Do you have a number?

A. We have provided this data, and it is about half a million dollars for renewable energy technologies per year in 1991 and '92.

Q. Okay. And part of that presumably is on solars?

A. Yes.

Q. Do you have a figure for that?

A. Not specifically, no.

Q. So --

A. But it is a small number.

Q. It is a small number.

A. It is a fraction of a small number.

Q. It is fraction of a very small number. 500,000 is presumably a fairly small number in relation to the total budget.

A. Yes. We provided that for the record in interrogatories 8.38.1.

Q. Yes.

A. And 7.14.22.

Q. Thank you. Yes.

A. One of them is your interrogatory.

Q. Yes.

THE CHAIRMAN: I'm sorry, what was the second one?

MR. SHALABY: 7.14.22. I think we made reference to them, Mr. Chairman.

THE CHAIRMAN: Have they been made reference to already?

MR. SHALABY: I think so, but I...

MS. KARISH: 475.19 is 7.14.22, and 475.20 is 7.38.1.

THE CHAIRMAN: Thank you.

MR. GRENVILLE-WOOD: Q. Now, the amount spent on solar was a small fraction of a small number, relatively speaking?

MR. SHALABY: A. A fraction of a small number.

Q. One small too many there for you? A fraction which you don't know.

A. Yes.

Q. You are aware of the fact, I'm sure, that PG&E's budget for renewable energy for 1993 is in the area of $10 million?

A. That doesn't surprise me. I am not aware of the numbers day to day, but...

Q. And in the last three years it has been approximately five million a year, so it is

increasing at fairly substantial rates.

A. Could be.

Q. Now, I guess the thrust of my question is, with this level of commitment that you are indicating from Hydro to research and development investment in these technologies are we essentially saying that we are going to be relying on offshore technologies and manufacturing in order to advance this technology in Ontario?

A. I think the answer is "yes".

Q. But at the same time you are aware of the fact that there are manufacturers operating in Ontario and in Canada who are capable of meeting increased demand?

A. I don't know for a fact whether we have production lines of photovoltaic facilities in Canada and in Ontario. There may well be, and certainly there are manufacturers who are capable of tooling up and making that material and that product. We have an advanced electronics industry that can, in fact, tool up and do this, yes.

Q. So, I mean, essentially, then, from what I am hearing you saying, is that Hydro policy is to let the developments take place elsewhere.

Now, is it because there is a positive

policy decision within Hydro not to invest in renewables and specifically in solar or is it that you haven't put your mind to it? Or what exactly is the problem?

A. I think it is very simple.

It is a product that we think is expensive at this time. Our mandate is not the development of all the technologies that may someday have promise. We, in fact, recognize the leverage that is possible by partnership with private industry and with organizations elsewhere in the world to reap the benefits without spending the dollars.

I think it is a fairly smart move on the part of various utilities and organizations. They pool their talents, they pool their resources, they follow the developments elsewhere, and when things start to look promising enough for a push and further investment they do that.

So I don't think it is a deliberate -- there is nobody sitting in Hydro and saying we deliberately will not invest in this. It is just that in the priorities of things -- and, as you well know, there is always competition for funds for research and development in any organization.

In ranking things, that category has

received half a million dollars in the research budget and about another three or four hundred thousand dollars in the design and development budget, and the corporation feels that between these two about a million dollars a year is an appropriate amount of spending for those technologies.

It is not zero, but it is not 100 million either.

Q. No, it sure isn't. Again, the solar ones are a small part of that again.

A. It is a part of it, yes.

Q. Now, the review itself is limited, from my understanding and reading of it, essentially to those technologies that add to the generation capacity.

A. That's correct.

Q. In other words, those technologies are supposed to send electrons down the transmission line, I suppose.

A. That's correct, yes. Or electrons down the toaster or refrigerator. It doesn't have to go down a transmission line.

Q. Now, have you not therefore in this review completely ignored those technologies that have the effect of saving megawatts?

A. We specifically say -- it is not

ignored. The scope of the study is technologies that generate rate electricity from, in this case, solar power.

We discussed other technologies that generate thermal energy, as in hot water, for example, or windows and passive solar designs, that can eventually impact saving power. Those are not part of the scope of this study.

Q. Could you explain why? I mean, why was it -- I mean, why did you draw that distinction around the scope of the review?

A. This review was made to focus on the contribution alternative energy sources can make towards meeting the gap in major supply requirements, the gap that is generated after demand management and after NUGs and after the hydraulic developments have taken place.

It is very specifically targeted to after we have done all the demand management, after we have done all the life extension and rehabilitations and so on, there always evolves a gap sometime in the future to be filled by a major supply.

And the question we wanted to answer is: To what extent would renewable energies play a part in filling that major supply gap?

So the question asked was: How would these technologies fill that gap? And that gap emerges after demand management has been taken into place. So therefore, the scope of that is for electricity generation only.

The other reason as well mentioned in the study is that there are all kinds of combinations, hybrid systems. Wind/solar facilities, for example, can work together, hydraulic/wind combinations, batteries with fuel cells or with solar facilities.

To finish the review in a reasonable time and to limit the scope - to do any study one has to limit the scope to get it done - we decided to limit the examination of hybrid combinations and to limit the examination of application of alternative energies in other things.

You are well aware, for example, that biomass supplies a lot of energy for purposes other than electricity. In the Third World, for example, biomass is half or more the energy form used by people for heating and cooking and on and on.

So this wasn't a project to examine the uses of biomass, nor is it the uses of wind, which is used in pumping and other purposes. So we had to focus our attention to in what way these sources will make

electricity.

Q. You say you had to focus in order to complete it in time. I mean, the question that comes to mind is, are you planning at some stage or other to devote as much time and energy to, for example, those technologies that contribute to the saving of megawatts? I mean, are you going to do a similar kind of review with a policy analysis and impact assessment in way of those other technologies?

A. We have discussed some of those in Panel 4.

Q. Yes, I know.

A. We will do more in due course. Perhaps we will forward to studies that SESCI is doing on solar technologies as well.

There are large funds devoted to solar facilities or solar technologies that SESCI is examining, and we look forward to those studies as well. That would complete our understanding of the market and the opportunities.

[10:40 a.m.]

Q. So you, as Hydro, haven't got something under way at the moment?

A. Not to my knowledge.

Again, not all knowledge comes from

Hydro. We rely on our institutions to provide knowledge, we can read it and learn from it.

Q. We are becoming increasingly aware that not all knowledge stems from Hydro.

A. I am glad you do, because it's something that we were keenly aware of all the time.

Q. Again, going back to the review, paragraph 1-5-1, I didn't mark the page down here but it's around page 25, I think it is -- no, page 27, point 3 refers to the Electric Power Institute, EPRI, and here you say that the photovoltaic capital cost below U.S. dollar is one, one U.S. dollar necessary for photovoltaics to produce power at 6 to 8 cents a kilowatthour.

The question is, this is an analysis of cost, what about considering the value of the resource or of the technology? For example, would it not be correct to say that whether PVs are cost-effective depends almost exclusively on their application, which is the point we made just a moment ago.

A. Yes.

Q. So making a broad sweep statement, what does that contribute to the analysis of the technology?

A. That statement is saying that for

photovoltaics to produce electricity at 6 to 8 cents a kilowatthour, the costs of the modules have to be less than $1 or at $1 per watt. That's all the statement is saying.

There are many applications that find photovoltaics economic and cost-effective at 40 cents a kilowatthour, such as navigation buoys, radio communication, remote environmental monitors, and on and on. These applications are content to use the electricity even at 40 or 50 cents a kilowatthour because the alternatives are also that expensive.

So just to saying to crack the large market of utility grid connections or to come to costs of 6 to 8 cents, the cost of the module has to come down a dollar per watt. That's all that statement is saying.

Q. And that's totally irrelevant regardless of the application. It's just across the board for grid-connected supply across the board?

A. Well, the grid-connected supply, the electricity on the grid is used for 1,001 applications.

Q. Yes. Okay.

A. And I don't know that we are putting a value judgment on what the application is.

Q. You just mentioned a few of the more

remote applications and I was going to draw your attention to what the State of Alaska is doing with respect to cathodic protection of communications devices. There is a report out, as you may be aware, that says that that type of application in Ontario could total 1 or 2 megawatts a years.

A. I wouldn't be surprised at that.

My knowledge of this, it's an application today, cathodic protection of pipelines and various other devices under way right now with photovoltaics.

Q. Another aspect of this review, just going through it trying to understanding, capacity and renewable credits are taken into account in your calculation, but I am not quite sure how the transmission and distribution benefits are included. Page 37 of Exhibit 344 is the area that addresses that.

I am just trying to understand how those credits were taken into account. Could you elaborate on that?

A. Page 37 you would like me to elaborate on?

Q. Specifically the transportation and distribution credits.

A. We are assuming that photovoltaics were installed on a rooftop, the applications we

examined were, one, on an residential rooftop, on a commercial or industrial rooftop. That electricity doesn't have to go through transmission and distribution and transformation, and for that reason it would save all of the above, losses and the cost of transmission lines, transformers, distribution feeders, and everything else. So we are giving a credit, the best estimates we can come up with, as to the average cost of transmission, distribution and transformation and giving that as a credit to a roof-mounted photovoltaic facility.

Q. So this again you are using an average figure?

A. Yes.

Q. Would it not be fair to say that the credit in many instances depends upon the locale of the application?

A. Yes.

Q. And that there could be a huge range in the costs avoided, if you want, by the application?

A. Yes, the answer is yes. And as an example, the exhibit Mr. Shepherd put in yesterday, Exhibit 504, there there was an example from Pacific Gas and Electric on distribution benefits of photovoltaics. That particular example, when analyzed,

showed much larger distribution benefits.

Q. That's the Shugar report?

A. That's right. That also is not typical. When I read it overnight, I understood that this was a survey of over 500 feeders and they selected the one that is the most in need of upgrade. Really this is sort of a highest benefit, as I understood it, selected from a large number of applications. And so, that is one example, that's not a typical example.

There may be examples that are higher in benefit in Ontario than the average. Some are lower in benefit than the average. For the purpose of the report that we did, having no specific application in mind we felt that the average was an appropriate number to put in.

Q. I think the point, I guess, I am addressing here with you is just precisely the usefulness of taking an average.

A. It has limited usefulness. It has a good first crack, but we also looked at sensitivity. If those benefits are increased or decreased, then the cost/benefit ratio for photovoltaics will be become more viable if the costs are increased and less viable if the costs are decreased.

The transmission distribution benefits

start to become a critical factor. If we are now close to one in viability, you start looking carefully at more of the parameters. But when the cost/benefit ratio is 8 or 9 at this time, we felt that spending time to refine estimates around the average perhaps is not very fruitful.

Q. But you have acknowledged that the remote applications even at 40 cents are economic--

A. Absolutely.

Q. --when compared to the alternative.

A. Yes.

Q. So when you are doing this kind of an analysis, an average figure really is totally meaningless because what you are really looking at is the application of the technology where particularly those transportation distribution costs are at their highest. So the average, you are taking in applications where they are almost zero, possibly, in your average

A. I don't want to mix the remote applications with the grid-connected applications.

Q. Okay.

A. The report is addressing grid-connected applications.

Remote applications are a separate matter

and we acknowledge right off that there are a large number of remote applications that photovoltaics is viable today and would be even more viable tomorrow. So that is not an issue anymore. We are now talking about grid-connected.

Q. So is it also not an issue where PV is an alternative to grid extension, that also is not in issue?

A. It depends how about the grid extension is, how much the load is. It's a fairly simple calculation really, how many feet of extension and how much the load is. And photovoltaic could become a viable alternative if you have a long extension for a small load, for example. It is not a viable alternative if it's a short extension and a large load.

Q. Okay. But that factor is not here, is not taken into account?

A. Not in detail. But it really becomes a remote application in a way. If you have an application even in the middle of a farm that is, say, 300 yards away from the closest distribution point and you want to measure something or pump a little bit of water or do some electrical application of some sort, it really is an application remote from the grid. It's

not 100 miles remote, it's 300 feet remote, and photovoltaics in fact could be viable in that case.

Our report shows a large number of those applications. Cattle feeding, aeration of lakes during icing periods, that kind of thing.

Q. But you are agreeing with me though that choosing a 100 kilowatt option and on a rooftop system applying a preset T&D benefit is not only arbitrary but of limited use?

A. No, I haven't agreed to that.

Q. I am asking you.

A. I am saying that if you use average numbers, average numbers have very large utility and benefit to analysts like myself, analyzing long-term potential of technologies.

They do not give the final verdict as whether the transmission distribution benefit in a house in Aurora or Smith Falls or Kapuskasing are going to be different. Those will be different. My speculation, they will not be significantly different to swing an 8.8 cost/benefit ratio down to 1. They may make it 6.8, they may make it 9.8, and so on.

It will change that ratio, it will change the equation, but not significantly enough to affect the conclusions we are reaching here.

Q. All right.

A. And again, for the sake of completing the studies and for the sake of reaching conclusions, we cannot explore every parameter at more detail than the decision at hand warrants.

Q. No, I agree with that. The point, I guess, is, in this particular technology the transportation and distribution factor has such a direct relationship to the application of the technology, that averages distort more than they would perhaps in other analyses?

A. They are people of the view that even average is quite a generous addition to the credit of photovoltaics. Some of the distribution engineers that I speak to say that we will not size a transformer or a distribution line any differently whether you have a photovoltaic facility at the end of the line or not.

In fact, transformers come in set sizes. If you tell me we are going to a subdivision that has photovoltaics or doesn't have photovoltaics, I am going to buy the same transformer, conductor sizes are the same. Codes and reliability purposes make the dualing of supply and so on the same whether you have this or don't have this.

In fact, we have to convince a lot of

people in the distribution and transmission business that in fact over the long-term, if you have reduction in load or if you have photovoltaics, or if you have wind, you are in fact going to incur savings over the long-term. It's not something that everybody is convinced of.

So that battle ranges on. That is not a given by all utility engineers and all distribution engineers.

Q. That goes back to the some of the earlier questions I talked about in terms of limited knowledge and limited understanding of the capacities of renewables within the family of the engineering -- not only in Hydro, but elsewhere.

A. I think the distribution people and transmission and designers in Hydro can understand the technology. But I would also suggest that people who are in photovoltaics could also understand the distribution and transmission business and understand why is it that it's not a one-to-one relationship. Complexities of transmission and distribution are immense as well.

I just want to leave the issue that the average is not necessarily bias one way or the other. In my judgment it's a good number to work with for this

purpose.

Q. If you look at the 12 per cent capacity figure that you have used, and I think that's on page 30, paragraph 1-7.3 -- sorry, no, there is another citation at that page that I want to refer to.

At 1-7.3 you talk about the annual average capacity factor could approach 16 per cent, but the general one you have used 12 per cent.

Now, I am aware, for example, that several northern U.S. cities have capacity factors between 15 and 18 per cent. Now, obviously we accept that those may be subject to some downward adjustment, but could you explain how the 12 per cent number was arrived at as a capacity factor?

A. I would think it's based on our extensive experience over 10 years in the 80s, and a little bit before that and a little after that, with the various installations that we have had in place in Ontario.

Q. So that is based on your experience with your experimental demonstration projects?

A. Yes.

Q. Any other source of the information?

A. I don't know whether its supplemented by any other modelling or theoretical calculations, but

I would think based in a large measure on our own experience in putting facilities in places like Toronto, Sudbury and Big Trout Lake, yes.

Q. You would agree, of course, that the comparative figures we have used here are based on Toronto, but there are places in Ontario where the insolation is greater than it is in Toronto?

A. It may well be, I would think if you go south to Windsor or something like that perhaps insolation would be slightly higher.

The map doesn't show that it increases tremendously, but I think the direction causes longer days and more sunlight hours, yes.

Q. Would an increase in the insolation rate increase the capacity factor?

A. Yes, it would.

[10:55 a.m.]

Again, for comparison I think when you go to the most favourable locations in Arizona and California I think the capacity factor is in the 20s - 20 per cent, 22, 25, somewhere in there. So I think we are not talking a very large increase in capacity factor if you go down a few miles or even a few hundred miles.

Q. You could also be going east and west

rather than just north and south from Toronto?

A. To my knowledge, that doesn't affect things very much. I think it is latitude that makes a difference, not longitude.

Q. My advice is, for example, that Ottawa has a higher insulation factor than Toronto.

A. Could it be cloud cover?

Q. Partly it would be cloud cover.

A. Urban smog? I know you people in Ottawa think this is a terrible place, but...

Q. It is a different kind of smog that comes from a hill near Ottawa.

A. Yes.

Q. If I could move to what you have chosen to use as a figure for photovoltaic capacity, and that is on page 23 where we are talking about -- I think in paragraph 1-4-1.2, the world PV capacity is nearing 200 megawatts.

Do you know where that figure comes from?

A. There are a large number of conferences and technical meetings that show, for example, what the annual sales of photovoltaics are year after year, and in the late '80s the sales have been in the 40 to 50 megawatts per year.

So I think the cumulative sales over the

last several years would add up to about 200 megawatts. They have been rising dramatically in the late '80s. Before that the sales were negligible.

Q. The reason I ask that question is that our analysis indicates that the current capacity is closer to 310 and there are some analysts who conclude that you are talking about 400 to 500 megawatts.

A. I wouldn't have much quarrel with whether it is 200 to 300 or even 400. It is really summing up the output of the major manufacturers and the sales every year, and to the extent people can keep tabs on who is selling what, where, and at what time...

We are trying to give an indication of what the world market size is just to be helpful to the Board here and to people reading this report.

Q. But you would agree that it is not necessarily an accurate representation, that there could be substantially --

A. I am saying the conclusions don't change very much whether it is 300 or 400. I don't know exactly what the accurate number is or where the authoritative source is, but for the purposes of this report it doesn't make much difference.

Q. I am interested to know why in the

discussion of the options that you have here, why a two kilowatt system was chosen. I know on page 32 at .5, 1-9-1.5, you give us a some rationale regarding the 14 square metres.

Did you conduct some studies to choose that particular capacity?

A. I think the purpose here is to give a representative system that we can say is something we can expect to see on a large number of roof tops, and the study says clearly that some houses could possibly incorporate larger systems, others because of orientation and shading may not be suitable for any solar installation.

So the idea of exactly an exhaustive study of what the typical photovoltaic facility of a particular house in a particular city would be is something that we haven't gone through.

But there have been others who have done back-of-the-envelope kind of calculations of how many roof tops are oriented the right direction, southerly direction, for example, and have the right inclination and not enough shading, and so on.

But to my knowledge that is a massive kind of data gathering exercise that is not warranted at this stage.

Q. You are aware, are you, of a pilot project in Germany where they were installing 1,500 units on houses and small businesses where they were using units in the one to five kilowatt range? So it would give you an average, if you want to use averages and the danger you have there, of 2.5.

A. I am not aware exactly of that, and if that is correct 2-1/2 kilowatts is not very different from 2 kilowatts.

Q. But a range of one to five. The range was from one to five, depending on presumably the...

A. Yes. I will accept that as a reasonable range for residential application.

Q. Hydro isn't planning to conduct any similar pilot projects maybe smaller than 1,500?

A. Not at this time. Not to my knowledge.

Q. Now, you refer in your review at page 24 of a Japanese project as well on...is it Rokko Island, where you have a 200 kilowatt peak roof top grid connected PV system being experimented with, or at least a pilot project there.

Again, that is I think a hundred homes, isn't it? Page 24 I think refers to it. Rokko Island,

yes, 1.4-1.16. Again, is the answer to the question that whether you were planning to do any demonstration projects of this magnitude in Ontario, is it also, not at this time?

A. Well, we are doing a hundred kilowatt demonstration at Sunnybrook Hospital right at this time.

Q. That is a one-unit...

A. That is a one-off deal and it adds up if it increases from that. I don't know of a megawatt scale demonstration that Hydro is planning on at this time.

Q. Okay. Now, this particular project on Rokko Island has been going for four years and is a grid connected system.

I am just wondering why there is no analysis given, for example, that this is operating now for four years without any reported problems, why you have in your review talked about a centralized facility rather than a more diffused facility that is still grid connected.

A. Where have you seen us talking about centralized facility?

Because my conclusions from our report is exactly the opposite. We are putting forth two

examples of decentralized systems, one on roof tops -- both of them on roof tops for different applications.

Q. Well, I am looking at page 28, 1-6-1, where we talk about land, where you talk about environmental considerations, and you have discussed there the problems with centralized facilities.

A. It is not that we are advocating central facilities. We are discussing the problems --

Q. No, but for purposes of comparison you use that approach, rather than a diffused, grid connected, roof top kind of home or small business connected system.

A. I am surprised. I don't see where the confusion is. We discussed land on page 28.

Q. Yes.

A. And based on that kind of conclusion, when you come to page 31, the options costed become decentralized roof top systems.

Because of the land question and the unanswered issues to do with centralized facilities, most experts agree that the early implementation of photovoltaic grid connections will be decentralized roof tops.

There are a whole host of other factors to be considered if you go into centralized, separate

land just for generating electricity. So we think that roof top is the way early applications will find a place in Ontario.

Q. All right. Well, that is helpful. Thank you.

Now, could you just tell me just in terms of that particular quote you have on page 28, where does the figure 225 square kilometres come from? Do you have a source for that?

A. I think the density of the megajoules per metre squared, times the conversion efficiency of photovoltaics, times the capacity factor of photovoltaics would lead you to a certain land area. Typically, they say there is a certain percentage for roads and services and for plates not to shade each other. So there is a particular density in any land area. The details are not put in place here--

Q. No, I understand.

A. --but land requirements are not an item of dispute in the photovoltaics business, I don't think.

Q. Well, it is interesting you say that, because our expert advises that his estimate would be 120, which is almost half, more than half.

A. 120...?

Q. Square kilometres, as opposed to 225. But I was just wondering if you had a source for that. That's fine.

A. I presume it could be a difference in assumptions about efficiency and about how closely you put the facilities together, not to shade each other and so on. But in either case, 120 square kilometres or 250 square kilometres is a massive piece of land, I would think.

Q. In discussions with Mr. Shepherd yesterday you indicated that there could be cost benefits from size with respect to roof top units particularly.

PVUSA, as you know, uses 200 to 400 kilowatt peak systems, whereas your option here again, as I indicated earlier, is 100?

A. Yes.

Q. Is there a particular reason why you chose the smaller unit?

A. Again, in the judgment of the authors of this report a typical industrial or commercial facility could accommodate a hundred. They even show the graphic illustration on page 32.

Q. Yes.

A. Again, the hundred is representative.

Some larger shopping centres, for example, could accommodate more than a hundred; some narrower - Scotia Plaza Towers, for example - would accommodate less than a hundred

So it is a representative number for --

Q. So it is just a judgement call as to the roof capacity that you figure would be average in Ontario?

A. Just a judgement call that a 35 metre by 35 metre commercial building in an array display like you see here. Just a judgement call, round numbers, to show --

Q. But you acknowledge that if you had used 200 the figures may have been different in terms of the cost/benefit?

A. The economies of scale, is that what you are referring to?

Q. Not just economies of scale, but the cost in terms of the size, in terms of the power, the energy that could be produced?

A. Most of it will be just doubling the capacity and the energy and the costs and everything else.

One of the beauties of photovoltaics is its modularity, that you add another module and you add

5 per cent more, another module and it is another 5 per cent.

Now, there may be economies of scale associated with constructing 200 kilowatts together rather than 100 here and 100 there.

Q. Yes. Yes.

A. The work crew, the inspection, the electrical connections. There may be a slight economy of scale, I accept that.

Q. Well, you know, Hydro did a study recently for the Canadian Electrical Association, and one of the buildings studied was the Bruce Generating Station where the capacity or the roof could accommodate I think it was a 318 kW system.

So just again, I presume that you are aware of that since it is one of your own studies and one of your own analyses, regarding the capacity of that particular experiment.

A. I am accepting that some buildings will accommodate more than 200 and more than a hundred, and others will accommodate less. Yes, I have no difficulty with that.

Q. Page 24, paragraph 1-4-1.21. In that particular figure you say that photovoltaic installations in Canada total 500 kilowatts.

A. Again, that is a moving target, as you indicated, in world capacity. It has come to my attention since that some people think it is up to 800 kilowatts, for example.

Q. Well, I was going to say that yesterday in response to questions from Mr. Shepherd you indicated with respect to wind that you were tracking and following EMR figures and that you were accepting those.

A. Yes.

Q. And my understanding is the latest critical assessment of EMR, for last year I think it was, indicates we were up at 660.

A. I even accepted 800. We are putting a hundred right here in Sunnybrook today.

Q. Yes.

A. It is a moving target. It is an industry that is growing at a rapid rate, and installations are coming into place at a very rapid rate. So any snapshot will be out of date fairly quickly.

Q. This isn't a snapshot that was taken yesterday. I mean, this is a snapshot that presumably...

I am just wondering --

A. Well before yesterday. It is September, '91.

Q. Yes.

A. And data available to us may have been early '91 or late 1990. This data is not updated as regularly as perhaps one would hope.

Q. No. Okay.

A. Again, the purpose was to provide the Board with some appreciation of how big that industry here in Ontario and how prevalent it is in providing electricity today.

Q. Well, I mean, the problem I guess I think of is, you know, minimizing in a couple of instances is counterproductive in a sense if you are trying to show the usefulness of the technology, and it seems on a number of fronts that that has been --

A. I don't think the intent was minimizing at all.

Q. I grant that.

A. It was relying on the most current data and acknowledging everywhere that that industry is a growth industry and moving very quickly.

Q. Now, I'm sorry to be bouncing around, but it is just sort of the way it flows in terms of the questions.

On page 19, paragraph 1-3-1.8, talking about the typical module, again I am just wondering where that size and where the 50 watt figure comes from.

A. We have had typically hundreds of modules at Big Trout Lake and at Atikokan and at different places. I have seen them. They are as described, .3 metres by 1.2 metres. Whether that is typical worldwide or in Ontario's experience, I don't really know.

Typically, the modules, as I understand it, would try and come out with a voltage. Each cell is about .3, .4, .5 volts. They are arranged in a way that would produce about 12 volts at the terminals. So I think it is a function of the area of the cell and the number of cells required to come up with a certain voltage.

Q. Would you be surprised to know that there are smaller modules currently available on the market which would deliver 60 to 75 watts?

A. No, I wouldn't be.

Q. And that others that are available as well that can deliver 100 to 120 watts?

A. I wouldn't be surprised.

Q. Similar size.

A. No.

Q. In addition --

A. Again, the idea we wanted to give here is a feel for the technology, what it looks like, how it shapes up here in Ontario, and the acknowledgement of the technology is moving towards smaller and denser and perhaps higher voltage is acknowledged. I have no difficulty with that.

[11:15 a.m.]

Q. Is it fair to say that the source for your information here is limited to your demonstration projects or did you have consultations with industry in Ontario and elsewhere to come up with these figures?

A. I think we relied on our demonstration experience. That's one of the reasons you do demonstration projects, is to gain firsthand experience and to be able to relay that to others. In fact, many others depend on our demonstration projects for data and for information. But I wouldn't say we are limited to that. Pages 39 and 40 show two pages worth of references that we relied on. And our experts are familiar with developments in the world and attend all kinds of technical conferences and demonstration activities, follow demonstration activities elsewhere in the world.

Q. You are certainly not aware of the fact -- I was going to add that very soon within this current year there are going to be units available that will be able to produce 230 watts, readily available.

A. I don't know.

Q. That just confirms what you were just saying.

A. I don't know. It may well be.

Again, the difference between availability in a laboratory setting versus availability in a commercial market, there are differences there. But none of that surprises me.

Q. I am not giving evidence here, but my understanding is that they will be commercially available.

All right. Page 35, and I am looking at figure 1-10-4, and where we talked about those cost figures that you have referred to a couple of times. The initial capital cost of options 1 and options 2, could you give us a bit of understanding, a bit of background on what is the basis for these cost figures? Where do they come from?

A. This is the 1991 cost, is that what you are asking for, or the year 2000 costs? Which one are you interested in?

Q. I am interested about both of them in fact, because I am not sure where the source is. I mean, there is an interesting drop between now and the 2000.

A. Yes. The 1991 cost is current marketplace prices, if you like, and we have seen evidence tabled by Mr. Shepherd that supports the idea that it's in the 6- to 7- to $8,000 per kilowatt at this time. The California Energy Commission I think showed 6,600 American dollars per kilowatt.

So, $8,200 or $7,200 for option 2 somewhere between 7,200 and $8,200 per kilowatt is today's prices.

The projection for decline into the year 2000 is rolling into that estimate an improvement in manufacturing, increase in efficiency, larger scale commercialization, better understanding of how to utilize the balance of system components and get more out of them and make them cheaper and more reliable.

So we see, sort of, costs coming down to roughly a quarter of what it is today.

Q. And these are estimates that you have obtained from just your own calculations or have you used --

A. Well, through contacts with the

industry and experts in the industry.

You mentioned, for example, the critical assessment study by Energy, Mines and Resources.

Q. Right.

A. There are EPRI reports.

A lot of people are dedicating effort to projecting what the costs of various technologies will be and we tap into that.

Mr. Shepherd tabled a study by National Laboratories that also projected costs of various technologies, including photovoltaics. Those are the kinds of sources that rely on to come up with figures like that.

Q. Did you not do projections beyond the year 2000 for a particular reason or is that...

A. Well, many people make projections as Mr. Smith, for example, said on gas prices. People think it's reckless to make projection two or three years in advance. Some go as far as the year 2000.

Q. How about 25 years?

A. Twenty-five years, for a rapidly moving technology like that, some people make those projections. We found that a snapshot of the costs in the year 2000 is serving the benefit or the purpose of this report.

We can project beyond that. As we went into scenario 3 in our analysis, if costs decline beyond that, then the market share will increase even further.

Q. Again, I presume that the same impact would arise on the cost/benefit analysis as you project into the future in terms of beyond the year 2000, if you can carry on the downward...

A. It's my belief that there are limits to how far the costs can go down, and the costs of the modules, the photovoltaic part of the photovoltaic facility has experienced dramatic declines and will continue to do so. But the photovoltaic system still has inverters, converters, it has glass, it has steel, it has concrete, it has labour. There are parts that are unlikely to decline at that such rapid rate as a photovoltaic cell itself.

A photovoltaic cell is a semi-conductor amenable to a huge cost reductions because of manufacturing and scientific breakthroughs. But the aluminum, the glass, the concrete, the transportation, the converter system, the wires, all of that is unlikely to experience such a drastic decrease.

So there is really a limit to how far down a stand-alone system would come down to.

Q. But you don't know where that limit would be reached. You are just assuming at the present time that by the year 2000 it will drop down significantly but you have no idea beyond that, I presume.

A. Many people think that would probably be an asymptotic relationship, it will hover around that level there, or that it's a reasonable assumption to assume it will stay around the $2,000 per kilowatt mark. The studies from California that we have seen Mr. Shepherd table do not contradict that.

MR. GRENVILLE-WOOD: Mr. Chairman, is it an appropriate time to take the break?

THE CHAIRMAN: Surely. We will take the morning break now for 15 minutes.

THE REGISTRAR: Please come to order. The hearing will recess for 15 minutes.

---Recess at 11:25 a.m.

---On resuming at 11:45 a.m.

THE REGISTRAR: Please come to order. This hearing is again in session. Be seated, please.

MR. GRENVILLE-WOOD: Mr. Chairman, I just spent a very traumatic 15 minutes with Mr. Passmore who has indicated to me that he's deeply hurt that I failed to introduce him at the beginning of today's session.

THE CHAIRMAN: We thought he had been here all night. [Laughter]

MR. GRENVILLE-WOOD: So for the record, assisting me is Mr. Jeff Passmore.

Q. Now, Mr. Shalaby, in reviewing my notes you referred earlier to the information package that Hydro sends out in response to inquiries about solar technologies, I think you said from hundreds of people. I wonder if you could undertake to produce a copy of the information package that Hydro provides on solar technologies?

MR. SHALABY: A. Yes, I would be pleased to.

The information I have is that we have had 10,000 copies printed and distributed. It's at various information centres, difference stations.

Q. It would be useful, I think, to have that.

THE CHAIRMAN: Do you have a 478 number for that?

THE REGISTRAR: 478.28.

THE CHAIRMAN: It should be a nice easy one.

MR. SHALABY: It is.

---UNDERTAKING NO. 478.28: Ontario Hydro undertakes to provide information package re solar technology.

MR. GRENVILLE-WOOD: Q. I just want to go back quickly to the Rokko Island project, that we discussed briefly earlier, in Japan. Are you aware that that is a grid-connected project that is connected to a relative small grid, 1.4 megawatt capacity grid?

MR. SHALABY: A. I am not familiar with the details, no.

Q. And that the photovoltaic provides 14 per cent of that grid's capacity?

A. Again, I am not familiar with that.

Q. You are not aware, okay.

In reviewing the transcripts of your cross-examination by Mr. Shepherd, I have noticed, for example, a number of points. For example, with respect to biomass you indicated that the optimal model was not used; with respect to wind power, you indicated that the projection for wind power are fraught with uncertainty because of the lack of good information of wind sites; you also indicated that the wind resource map in the review was too preliminary and that more prospecting would be required for the map to be more reliable; you also said that Hydro is not wedded to the wind numbers and that this projection could range from

40 megawatts to 1,000 megawatts.

With respect again to biomass you indicated - not necessarily you but perhaps it was Mr. Dawson - that substantial agricultural options were not included. Today you indicated, for example, that the solar map may be subject to some adjustment because of the flat nature of the map as opposed to more angled collectors.

We have indicated as well that the review does not deal with the energy saving technologies, if you want to use that term.

In addition to that today you have indicated with respect to figures that a lot of the figures you have used here are moving targets, that the review is just a photograph. You didn't know what the authoritative source was for certain numbers. You indicated as well that the whole purpose of the review is to give a feel for certain concepts and technologies.

The problem I have with this sort of litany of uncertainties is, what is the purpose of the review? I mean, how can we rely on the figures you have produced if everything has got either uncertainty or you are not sure whether the source is correct, or whether figures are the latest figures, and so on.

What are we supposed to draw, what sort of conclusions should we draw, should the Board draw from this review?

A. I think the conclusions are very clearly written down and articulated in the summary at the end of each chapter. Those are the conclusions we draw and would like the Board to draw.

Q. But they are based upon a whole series of figures where you seem to have indicated that you aren't particularly wedded to the numbers you have used, that there are other numbers that could have been used, that there are more up-to-date pieces of information that are available and so on?

A. I think planners and decision-makers all along have to reach conclusions in the presence of uncertainty and in the presence of complete information, and this is a typical example of that.

We do not know all the data that you alluded to, some of the data is not completely gathered. We are in the business of projecting, manufacturing and technical breakthroughs, commercialization effects. In spite of all of that, we have to reach a conclusion today, considering all those factors and those uncertainties, and we reach very solid conclusions.

The fact that there are uncertainties

does not detract from the validity of the conclusions we have reached.

Q. Surely a couple of things, you say it should give the Board a feel for the technology. Those were your words, I think.

A. I don't want to debate with you whether that applies to the entire report. When you were saying the size of the module is so and so, I said we wanted to give the Board a feel of what the module looks like.

When you said whether the capacity in Canada is 500 kilowatts or 650 kilowatts, I said both of these give the Board a similar feel.

This is not a multi-billion dollar industry in Canada; this a small scale industry.

These are the two instances I meant give a feel for the size of the industry, the size of the module, the state of development. But I wouldn't characterize that everything is in that category. I am being flexible in accepting that it is a snapshot and there are other estimates that could be valid. It doesn't detract from the conclusions we reached at all.

Q. But the impression that's left could be quite different if you use some of the other figures that are available. Don't you agree with that?

A. No, I don't agree with that. I said that even if I accept multiples on the transmission losses or multiples on the installed capacity in the world, whether it's 200 megawatts or 400 megawatts, I specifically said that does not specifically change the conclusions I am reaching here.

Q. It doesn't change your conclusions but it leaves a different impression. There's a magnitude of 100 per cent difference between those two figures, for example. If you draw to the attention of the Board and others reading the review that there is 200 megawatts when in fact there is 400 megawatts and that you fail to say that there is an exponential growth or you don't say it in the same context, then that leaves a different impression.

A. Well, if it does leave a different impression, that's the way it is.

Q. Okay.

A. The context in which I am making these remarks is that I don't want to argue about details because the big picture is not affected very much with details like that. Even though 200 is half of 400, that is still a detail.

Given that generating capacity in Canada and the United States in hundreds of thousands of

megawatts, a difference between 200 and 400 is not a significant one.

Q. But again, I am not going to get into a debate with you, I think conclusions can be drawn from those comments.

In any event let me ask a couple of questions. One of the interesting things that I looked in examining the alternative energy review that came to my attention is that despite the fact that this is an environmental hearing that we are participating in, there is really very little in here about environmental costs and benefits. I know we have discussed this in other panels. But the question that comes to my mind is, has Hydro undertaken or is Hydro undertaking any further study regarding, first of all, what you might call internalizing external costs, and will that form any part of your future reviews of alternative technologies?

A. Yes and yes.

Q. So you are undertaking further studies on external --

A. Hydro continues to do studies on various aspects that affect our business, including the area of externalities, including the area of evaluating different options.

Q. Including the area of what, sorry?

A. Evaluating different options and how that evaluation is affected by conclusions we reach on externalities.

Q. This question of the studies with respect to externalities, is it a formal study that you are aware of, or is it just general work that you are undertaking?

A. Work that different parts of the organization are undertaking.

Q. So there is no special study under way?

A. I don't know what makes a study special or unspecial, but it's work people are doing in the economics function and in the environmental function, that it is an emerging issue in utility panel of planning, the issue of externalities, and as a major utility we are interested very much in what is evolving in that and what our position on it will be.

Q. In the context of the planning process, which is what we are looking at now, if you were to do a new alternative energy review in the short-term or median term future updating this particular report, would it be your intention to include the results of those studies in your evaluation

of the technologies?

A. If Hydro has come to different conclusions on externalities, different than what we reflect here, we will include that, yes.

MR. GRENVILLE-WOOD: Thank you, Mr. Chairman. Those are my questions for this panel.

THE CHAIRMAN: Thank you, Mr. Grenville-Wood.

MR. GRENVILLE-WOOD: Thank you, panel. Mr. Shalaby.

MR. PASSMORE: I won't be here for the next cross-examiner.

THE CHAIRMAN: You are not the next expert.

MR. PASSMORE: No. Had I been hired by all the intervenors, we could have saved a lot of time.

MR. GRENVILLE-WOOD: That's debatable.

[Laughter]

MR. PASSMORE: Mr. Shalaby will be glad that I am not.

THE CHAIRMAN: Mr. Mattson, are you next?

MR. MATTSON: Good morning, Mr. Chairman.

Mr. Chairman, I don't plan to be very long this morning, possibly half an hour. But if I could begin by introducing the three exhibits that I

plan to refer to and getting exhibit numbers for those three documents.

THE REGISTRAR: Would you please identify them?

MR. MATTSON: Yes.

The first one is entitled Selected Articles on the Increased Use of Natural Gas in Place of Coal for Electricity Generation in the UK.

THE REGISTRAR: That will be No. 508

---EXHIBIT NO. 508: Document entitled Selected Articles on the Increased Use of Natural Gas in Place of Coal for Electricity Generation in the UK.

[12:02 p.m.]

MR. MATTSON: The second is entitled Energy Market Update, article entitled What is Coal Bed Methane?, January 1992.

THE REGISTRAR: 509.

---EXHIBIT NO. 509: Published article from Energy Market Update, article entitled What is Coal Bed Methane?, January 1992.

MR. MATTSON: The final one, Mr. Chairman, is entitled "Statement on Integrated Resource Planning for Natural Gas Distribution."

THE REGISTRAR: 510.

MR. MATTSON: Thank you.

---EXHIBIT NO. 510: Article entitled "Statement on Integrated Resource Planning for Natural Gas Distribution."

CROSS-EXAMINATION BY MR. MATTSON:

Q. I would like to begin by dealing with an issue that was left over from Panel 5 and was referred to this Panel.

If you turn to transcript Volume 77 at page 13,745. It was a discussion or a series of questions asked of Mr. Snelson of the advantages and disadvantages of coal- versus gas-fueled generation.

If you look to the top of the page you will note Mr. Snelson identified a number of benefits gas has over coal, including lower CO(2)s, SOxs and NOx, and at line 10 to 17, I will read into the record, Mr. Snelson said:

> The discussion was also about social characteristics and other such characteristics, and a gas-fired option is using the fuel that is relatively scarce measured over many decades whereas coal is a fuel where the identified resources are measured in centuries rather than decades. So it is a much more plentiful resource. So there is much less chance of depletion of the

natural resource.

My questions - and I am not sure who to direct them to - I take it while gas may be a more scarce resource than coal that Hydro is now measuring proven gas resources as lasting at least another five decades; correct?

MR. SMITH: A. No, that is not correct.

What we have said is the proven reserve is not necessarily the way to look at gas and its availability for the future. The proven reserve is what it is. In the United States it is something under ten years of supply at current levels of consumption and in Canada it is about 20 years of supply at current levels of consumption.

What I did say, though, in my direct testimony was that you should look at likely available reserves. That is just my words as opposed to the words that the industry uses; they have different terms for degrees of availability.

And then I said, looking at it in that way you would begin to recognize that the reserves are probably in the neighbourhood of 50 years.

So you are right. It is five times, but it is not a proven reserve.

Q. Mr. Smith, I believe you also

indicated in direct evidence that Hydro has not included the potential for development of Canadian or American coal bed methane in your natural gas pricing, on projections; correct?

A. I think I said that we had included, made an allowance for coal bed methane in the assessments of reserves in the United States but not for Canadian reserves.

Q. So when we are talking about the likely availability of natural gas being five decades that wouldn't include any estimation on coal bed methane?

A. Well, the U.S. portion had, I believe we said, 90 trillion cubic feet of coal bed methane were included in our numbers. So within that 50 years, yes, but there was no allowance in Canada.

Q. Mr. Smith, could you explain to the Board what coal bed methane is?

A. Very generally it is a gas that exists in coal seams and which is released to the atmosphere generally during the mining process for coal. It was naturally formed when the coal was formed, and it is a developing technology that rather than mine coal and release the methane that you release it without actually mining the coal. It becomes a

source of fuel that is equivalent to natural gas.

Q. When you say "equivalent to natural gas" would it be then considered a substitute for conventional natural gas?

A. Yes.

Q. Mr. Smith, if you turn to Exhibit 509, one of the ones I have just filed, it is entitled British Columbia Ministry of Energy, Mines and Petroleum Resources, Energy Market Update, January, 1992. Have you had an opportunity to review this paper?

A. Yes.

Q. If I could just direct your attention to a number of points in the paper I would like to ask some questions.

First of all, on the first page on the lefthand column under How Much Coal Bed Methane is There?, I am reading:

> Potential reserves of coal bed methane are estimated at between 2.7 and 81 trillion cubic metres in the U.S. and between 3.7 and 12.7 trillion cubic metres in Canada. The large range in estimates is due to lack of data.

If you turn the page at the bottom of the

first paragraph in the left-hand column it is talking about in British Columbia, and it says:

> For comparison, the total discovered conventional natural gas reserves for the whole province of 454 billion cubic metres with remaining reserves of 230 billion cubic metres...

Mr. Smith, in terms of the amount of gas available there is a great deal of untapped potential there with respect to coal bed methane; is that fair to say?

A. Yes.

Q. Has Ontario Hydro done any studies on how this potential might at some day or at some time come into Ontario?

A. No.

Q. If you turn to the very last page of the exhibit, the very last paragraph reads:

> Coal bed methane is a vast energy resource whose recovery will depend on price, market forces and regulatory standards.

Mr. Smith, is it fair to say that if natural gas prices begin to increase that coal bed methane will become a more attractive alternative to

conventional natural gas?

A. I'm sorry, a more attractive alternative than conventional natural gas?

Q. Yes. If the price of natural gas begins to increase?

A. No, I don't think so.

Q. Won't be more?

A. I think it will become attractive if the price of natural gas goes up, but I don't think it will be more attractive than the conventional method of recovery.

Q. No, but certainly there is a relationship between the price of natural gas and the attractiveness of coal bed methane; correct?

A. Yes, because of the investment required to recover it.

Q. What effect do you think this may have on the long run price of natural gas?

A. How long run? I think what it would do, it would tend to, if it gets developed and if it is as plentiful as people any - and people at the moment are being very conservative in their views of how much of this gas will in fact be recoverable - the availability of it would tend to dampen price increases.

Q. Has this possibility or likely scenario been taken into account in forecasting Ontario Hydro's natural gas prices?

A. At this time, no.

Q. If I can move on to another area, I would like to talk about pricing of fossil fuels and electricity generated by fossil fuels, and I take it that -- and I won't duplicate any earlier evidence and if I could just quickly paraphrase, I take it from your evidence that residual environmental impacts - that is, the impacts from facilities operating within pollution control regulations - are not reflected in price; correct?

THE CHAIRMAN: Reflected in the price of what?

MR. MATTSON: The price of the product.

MR. SMITH: I think maybe you should try the question again. I got lost in it. I'm sorry.

MR. MATTSON: Q. Sure. That the residual environmental impacts, the impacts that is, from facilities operating within pollution regulations, are not reflected in the price of electricity.

MR. SMITH: A. I believe that is correct, yes.

Q. Mr. Smith, if this policy were to

change and include environmental externalities in the price to consumers is it fair to say that gas would be more attractive to the consumer relative to oil- and coal-fired electricity?

A. It depends - and that is not a very good answer for you but - it depends what you compare it to.

If you compare it to state of the art, brand new coal plant with all the right environmental controls on it, the newest type of environmental controls or perhaps a technology such as IGCC, then I am not entirely sure what the difference would be.

I think we have all acknowledged that natural gas environmentally has less of an impact than coal, but you can do things to control some of the impacts of coal.

So then the residual effects vary, depending on what it is you are comparing it to. If you compare it to the cleanest type of coal, then the differences become quite a bit smaller, and I am not sure -- I don't have any data that tells me what the price change would be and how much that would change the outlook for gas.

Q. No, I understand, and that is helpful.

The preferability of gas over coal- and oil-fired electricity is consistent, however, with the fuel switching initiatives in Bill 118 and those potential initiatives which your Demand Management Panel spoke to earlier in the hearing; correct?

A. Yes.

Q. Now, is anyone on the panel aware that there is right now an inquiry process under way at the OEB into integrated resource planning for the gas sector in Ontario, and the purpose, to find ways of creating a more socially optimal allocation of resources in the gas sector with particular attention to achieving environmental benefits?

A. I am aware of the process, yes.

Q. Well, then, I will paraphrase. Is not then the purpose of the IRP, the Integrated Resource Planning, to find an energy strategy to cut environmental impacts and resource allocation strategy to optimize it?

A. That is one of the purposes. I think there were many other purposes cited in the announcement.

Q. Mr. Smith, one of the issues is how to encourage fuel switching from electricity to gas for environmental reasons?

A. I am not sure that it has been expressed in that way.

I am aware that we have a concern in the hearing that in fact some of the things that we are looking at might mitigate against moving from electricity to gas, depending on the outcome of the review. But I am not just not familiar with that wording. It may be there. I haven't read all the documentation.

Q. Do you anticipate, Mr. Smith, that the hearing or the findings of the OEB might impact your plans before this Panel?

A. Well, I can't prejudge what the OEB may find and determine in the process.

Q. But certainly you would agree if the OEB made changes that made gas a more aggressive competitor with electricity that this could have an effect on both end use markets and your power generation market for Ontario Hydro; correct?

A. Well, I think we are getting into areas that I think Panel 10 will deal with, specifically on how these things trade off, but we all have to bear in mind that regardless of what the OEB determines the biggest driver in the price of natural gas is the commodity in Alberta and then delivery of it

to Ontario. And then what the OEB does with the pricing regime or direction to that regime will have an impact on the distribution and some of the pricing of their services perhaps.

So I would have to put it in that context, that whatever they do will have some impact, but we have to bear in mind that the vast majority of the costs are determined before they get to Ontario.

Q. And those costs are determined in a competitive market; correct?

A. Not the national transportation costs, no, but the commodity in Alberta, generally yes.

Q. Maybe, Mr. Smith, you could help me.

If you turn to Exhibit 510, this is the exhibit paper filed by Dr. Larry Ruff, dated February 28th, 1992, to the OEB. If you turn to page 25 of the exhibit I would just like to read one sentence at the bottom of the page, starting with "For example":

> Even if the price of gas is too low because it does not include all the environmental impacts of gas production and use it might be that the gas price should be decreased even more or the price of gas-conserving services should be increased if other dirtier energy

forms cannot be priced to reflect their external environmental cost.

Now, Mr. Smith, would you agree with the substance of that statement?

A. Well, I think I have to read it in the context of the whole paper.

Q. Well, would you agree --

A. I guess what I generally agree is that if gas is an environmentally attractive fuel then we should give it all consideration, which we do.

Q. Would you agree that the environmental damage could increase if we had economically efficient prices - that is, applying the pollute or pay principles - for cleaner fuels while dirtier electricity is free from these principles?

A. I would think the statement is too broad for me to agree with it. There is a lot more to it than a simple agreement "yes" or "no" to that statement.

Q. Maybe you could extrapolate on that. Tell me what is it that you would disagree with in that statement?

A. Well, I guess there are many aspects of it.

You are implying that, first of all, the

result of the hearing is going to be that the Board is going to include externalities into the pricing of natural gas and at the same time not include externalities into the pricing of electricity.

You talk about dirtier electricity, and electricity is produced in many different forms in this province, and some of it is, at least in some people's views, environmentally superior to using natural gas for it, too.

So it is too broad a statement.

Q. All right. But disregarding the -- don't make the assumption that Board is going to do this, but generally if you include externalities in the price of one fuel and not in the price of other fuels it is going to make the one fuel less competitive; is that not correct? The fuel or the externalities included.

A. Yes. Yes.

Q. Okay. Now, Mr. Smith, why does Hydro on one hand endorse and contemplate subsidizing programs to get people to switch from electricity to gas and yet on the other hand you are continuing to put more money into repairing oil and coal peaking plants to expand their production? How can both these things be cost effective?

A. Well, maybe Mr. Meehan can answer that.

Q. Sure.

MR. MEEHAN: A. I first of all don't see why they wouldn't be cost effective. I think you are looking at two different things.

Q. What are those two things?

A. Well, you are looking at fuel switching in a domestic market and you are looking at burning gas in a utility.

If you are wondering whether we think we could construct a combined cycle and burn gas cheaper than we can rehabilitate, say, Lambton and burn coal and add all the environmental control equipment, we feel that we can rehabilitate the coal plant and do it cheaper than we can even just burning gas in a boiler, say.

Q. Mr. Meehan, as an end use product for the consumer to use electricity or gas, certainly Ontario Hydro is now endorsing and encouraging fuel switching; correct?

A. I believe that is the case.

MR. SMITH: A. For certain applications.

Q. Fine. Why would that be? Is that not because natural gas would be a cleaner, more

environmental fuel, more efficient, more effective than burning of coal and oil which are used during peaking operations by Ontario Hydro?

[12:20 p.m.]

MR. MEEHAN: A. I would think the reason that we are endorsing that is because we won't have to install new generation facilities perhaps. So it's a cost issue more than anything else for Ontario Hydro.

MR. SHALABY: A. I think we also discussed in Panel 4 that using gas at the residential market, which Mr. Meehan alerted you, that is a significant difference, gas is used at 90 per cent efficiency. Using gas at a generating station is a 30, 40 per cent efficiency proposition.

So using gas at the end market offers a lot of efficiency advantages to the province as a whole.

Using coal has got the reverse consideration. Using coal at the domestic level is cumbersome and you cannot put in environmental controls as much as you can in a centralized facility. For that reason coal perhaps makes more sense to be used centrally where you can put all the environmental controls that we spoke of that you cannot put off at a residential situation. Using gas is a reverse: it is

more efficiency used at the house than it is at the generating station and it doesn't need an awful lot of environmental controls.

Q. Other intervenors have already asked questions with respect to justifying the cost-effectiveness of the extensions versus building new gas-fired plants, et cetera, and I will avoid that. But I would like to ask the question if anybody on the panel has analyzed or is aware that in the United Kingdom before privatisation that the electric utilities had extensive fossil rehabilitation plans for existing coal plants?

MR. MEEHAN: A. I am sorry, what was the question at the end there?

Q. That prior to privatisation in the United Kingdom the utility had extensive plans for rehabilitation of their coal-fired plants, their existing coal-fired plants?

A. By rehabilitation do you mean the additional of scrubbers and things of this nature, or do you mean what we have been referring to as rehabilitation and life management?

Q. We are referring to the latter, life management.

A. I understand that they were going to

be doing a lot of that, yes.

Q. Mr. Meehan, are you now aware that since the UK electricity privatisation that many of the private generators are shutting down their existing coal plants, retiring them early because maintaining and fueling the old coal plants is less cost-effective than building a new, high efficiency gas-fueled plants?

A. I am not terribly aware of that. I think there is a situation though in Britain though that is quite different than ours here.

As members of the common market they were required to make extensive changes to their SO(2) production mostly. I don't think they could retrofit scrubbers fast enough to meet the requirements of the common market. It may be one other reason that they are looking at gas.

I think the price of gas there is also a factor. So there is a number of different factors that would make their situation quite different from ours.

MR. DAWSON: A. The price of coal, for instance, is also more expensive in the U.K. than it is here, and they have closed down a lot of mines because they are uneconomic and there are importing offshore coal.

MR. SMITH: A. Privatisation allowed

them to stop buying the coal on a compulsory basis from that mining industry at high prices.

Q. That's correct.

A. So if that hadn't changed they would still be buying the coal.

Q. That's correct. The private suppliers were able to chose the most economic and efficient fuel on the market; correct?

A. Yes.

MR. BURPEE: A. PowerGen, one of them is still counting on extended lives for their fossil facilities for a good deal of them, though.

Q. Let me just take you through a number of articles that we have pulled from the British Press, Routers, and maybe I can ask a couple of questions about those.

It's Exhibit 508. If you turn to page 2 of the exhibit first. I will just quickly go through them and then we will have comment.

Page 2 it talks about "Electricity Sell-off 'Has Green Benefits'.

"Privatisation of Britain's electricity industry is benefiting the environment, Professor Stephen Littlechild, the director general of

electricity supply, said yesterday. The impending replacement of large amounts of coal-fired generating capacity with combined cycle gas-fired power stations will help to cut emissions of sulphur dioxide, which contributes to acid rain. Because these stations convert more of the heat from their fuel into electricity, less fuel will need to be burned, Professor Littlechild said.

"Opening the market to competition has therefore focused attention on a different technology, producing an environmental benefit. I am confident that as the competitive market develops further efficiency gains will be identified by generators, suppliers, and customers producing similar environmental benefits," he said.

On page 3 of the exhibit, just quickly. Energy Secretary Welcomes Lakeland Power Station, October 8th, 1991.

"Mr. John Wakeham, the energy secretary, said today that about 20 significant private power station

projects were in the pipeline. He was speaking after opening of Roosecote power station near Barrow-in-Furness, Cumbria. The plant which runs on natural gas is the first independent station to be opened since privatisation of the electricity supply industry. Roosecote is owned by Lakeland Power, which bought the redundant sites coal-fired power station and undertook a #100m conversion."

Finally on page 5, I believe its highlighted for you. A third the way the down the page.

"When Mr. Wakeham, the energy secretary, broke up the state-owned Central Electricity Generating Board and consigned its non-nuclear element to the private sector as National Power and PowerGen in February, few could have imagined the scale of the restructuring that would ensue.

"National Power and The PowerGen rely on huge coal-burning power stations for most of their capacity.

"The regional electricity generators, power station builders, and foreign utilities were quick to spot that power could be provided more cheaply by new combined cycle gas-fired power stations. These achieved thermal efficiency of up to 54 per cent, compared to 37 per cent achieved by the best existing coal plant."

The question from reading that, at least, and I understand your concerns, Mr. Smith, that in Britain there are different prices, and, Mr. Meehan, there are different pricing factors involved. In fact, I believe that natural gas is held by a monopoly in Britain whereas here we do have a competitive market. But has Hydro weighed the market evidence in the U.K. that new gas-fueled electricity generation is cheaper than the coal rehabilitation when considering your own coal rehabilitation plans?

MR. MEEHAN: A. I am not aware in any detail what their situation there is. Their price of their coal may be more expensive than the gas price, I don't know.

Q. Do you know if in the U.K. it's true that gas is more expensive than it is in Ontario?

A. I don't know that.

MR. SMITH: A. I don't know that. But I have my doubts. But I don't know that.

Q. You doubt that it is more expensive?

A. Because it's not very far to transport it for one thing. But I don't know.

I do know that coal is much more expensive than it is here.

Q. If I can turn to my final issue this morning, and that has to do with wheeling.

Again, if you could turn to Volume 77 of the transcripts, page 13804. This is Panel 5 when we were discussing the issue of wheeling with Mr. Vyrostko. If you looked at line 6 to 10, Mr. Vyrostko defined wheeling, and I am reading:

> Wheeling generally is the transfer of power between two operating utilities that can then use that power to advantage to themselves under specific circumstances.

Now, Mr. Smith, could you explain to the Board how third party wheeling practice of wheeling in the gas industry works?

A. No, I am not really that familiar with it, not in those terms.

Q. Is there anybody on the panel who is familiar with that?

Mr. Smith, are you aware of a different definition of wheeling or third party wheeling, at least, for the gas industry than the one given by Mr. Vyrostko in the transcript?

A. No.

Q. Mr. Smith, are you aware of how competition between gas suppliers works here in Ontario?

A. Which gas suppliers, the Ontario gas suppliers, Consumers Gas and Union Gas?

Q. The wells, the producers in the field.

A. In Ontario?

Q. In Alberta, Saskatchewan, wherever the oil and gas is coming from.

A. I'm sorry, you said Ontario and I wasn't aware of any large producers that were in competition in Ontario.

Well, basically yes, they bid a price to a buyer and it's a competitive price.

Q. A consumer can buy that gas from the well, correct, from the producer?

A. Yes.

Q. Would you consider that to be third party wheeling?

A. Well, no, I don't think so.

I think what you are saying is there is a transportation system in Canada that one can use and you can use it without being a Union Gas or whatever. You can be an end-user of gas, you can purchase gas in Alberta and you can have it transported to Ontario.

So if that's what you are talking about for wheeling, yes, I am very aware of that.

Q. That is what I am speaking about when I am speaking of wheeling. And that is different from what wheeling is in Ontario with respect to what Mr. Vyrostko defined in the transcript; correct?

A. Yes, it is different.

Q. Mr. Smith, Hydro purchases small amounts of gas, I take it?

A. Very small, yes.

Q. And Mr. Smith, has Hydro benefited from the third party wheeling in the gas industry?

A. Yes.

Q. So you make direct purchases of gas, you don't by from the utility; is that correct?

A. No, we buy from the utility. It's only a very small of gas at Atikokan, but we get a

discount that's equivalent to the buy/sell arrangement that you can have.

Q. Okay. Now, is it your perception also, Mr. Smith, that the most participants in the gas industry, utilities, industrial consumers, general customers and the OEB regard wheeling and direct gas purchase by customers from producers to be a success, to have been a success since it was implemented?

A. Yes.

Q. And are you also aware that this practice has been implemented in the electricity sector in British Columbia?

A. I am not aware if that, no.

Q. Is anybody on the panel aware that this process has been implemented in the electricity sector in British Columbia?

Thank you, Mr. Chairman those are all my questions this morning.

Just for the record, no one answered, I take it that was a no; correct?

MR. SMITH: No one on the panel is aware of that issue.

THE CHAIRMAN: I think you can take that as no one is aware of it, that's right.

MR. MATTSON: Thank you.

THE CHAIRMAN: Thank you, Mr. Mattson.

MR. MATTSON: Thank you, Mr. Chairman.

THE CHAIRMAN: Mr. Power?

MR. POWER: Yes, sir.

MR. POWER: I take it you wish to proceed now rather than take an early lunch.

THE CHAIRMAN: Yes, if you don't mind. People have their daily schedules worked out and it disrupts them if you change the time.

MR. POWER: Only one comment, if I may. I think counsel for Ontario Hydro will agree, we had some questions back and forth about relevant interrogatory questions last Thursday. We got the information from Hydro, I have fired it off to our consultants and we are still awaiting the response from our consultants. I haven't got the information. I don't think my friend has any problem with my splitting up my cross-examination and to come back tomorrow to follow up, so if that's acceptable...

THE CHAIRMAN: That will be fine.

MR. POWER: Sitting beside me is Dr. Mark Rosen, I might add.

There is a package of materials, that was provided earlier. It has a nice glossy on top. There is a series of those in the back room for anybody who

is interested.

I believe the Board members have received most of those, or the panel members have received most of those last week.

CROSS-EXAMINATION BY MR. POWER:

Q. In terms of what I will be crossing on, I wish to get into Ontario Hydro's role as a cogenerator of electricity and thermal energy where Hydro uses its own generating station to produce electricity and thermal energy simultaneously, much alike to a NUG but Hydro plays that role.

I then wish to ask a number of questions relating the opportunities associated with Hydro playing this role and some of the environmental, socio-economic and other benefits.

And depending upon if I get the information from my consultant, I may address hydrogen later today or I may leave that to tomorrow, and hydrogen and the use of fuel cells.

My only other comment, just to make sure this is clear, there is many different ways to cogenerate and I understand there is many definitions of cogeneration. I will be focusing on the cogeneration of electricity and heat from either fossil fuel generating stations or uranium, i.e. from one

energy source. And when I refer to heat this can be in the form of either steam or hot water.

I guess just as a further clarification, I don't think some people refer to two types of processing heat from generating stations, one some people refer to as waste heat recovery; that is, where the heat which is presently discharged into the Great Lakes is recovered through upgrading. This upgrading is done by pulling all of the heat that is otherwise discharged to the Great Lakes off of the turbine line and distribute it to users directly. And a lesser version of that is called extraction steam where you just remove a small amount of the steam off of the steam line and provide it to a user.

I am not sure who address these to, but, Mr. Shalaby, I will start with you and see where we go from there.

I believe you have in front of you a nice fancy glossy entitled A Clean Solution, up top.

I think we should mark this as an exhibit, if I may.

THE REGISTRAR: The next exhibit number, Mr. Chairman, is 511.

---EXHIBIT NO. 511: Document entitled "A Clean Solution?" by the International Energy Agency and the World Energy Council.

MR. POWER: Q. Have you had an opportunity to review this, Mr. Shalaby?

MR. SHALABY: A. No. I just got it this morning and I am just leafing through it now.

Q. I believe these materials were provided sometime last week, but --

A. Other people ahead of you provided me with more material to occupy my time.

Q. I hear what you are saying. We will try and to the best we can.

I think if you flip open the first page you will note on the inside of the cover, the top left-hand corner, that this brochure is produced by the International Energy Agency and the World Energy Council. Are you familiar with these two bodies?

A. Yes, I am.

Q. Are these well-known and respected agencies in the area of energy research?

A. Yes, they are.

Q. Thank you.

If you then flip over to three pages on, to where the words, "An Efficient Combination: Cogeneration of Heating, Power and Cooling", and we will see a little diagram of the utility which is

producing electricity. Do you have it?

A. Yes.

Q. Thank you. This diagram demonstrates what is a traditional utility generation station, a fossil generating station. If you will note there is an electricity line going off to the right of the station, you will note that there is a stack beside that, and beside the station as well there is something which a cooling tower.

What this diagram attempts to do is demonstrate what the capabilities of the conventional coal-fired or fossil-fired generating station can do if its operated in a cogeneration mode as opposed to electricity-only mode.

You will note that on the left that there are eight blue barrels that represent the energy that is consumed, and you will note that one barrel is lost up the chimney, one barrel of energy, and that in the traditional electricity mode four barrels of energy is lost through cooling, and in this example would be the cooling tower or in Ontario I believe the equivalent would be discharge of energy into the Great Lakes.

Three barrels of energy, in essence, then go out on the transmission line, and that's what this document is asserting, that of the eight barrels of

energy, you get the get the equivalent of three barrels going out on the electricity only if it's not in the cogeneration mode.

Mr. Shalaby, to your knowledge, Ontario thermal stations, fossil-fired, are they presently approximately 35 per cent energy efficient?

A. That was evidence given by Mr. Dawson, yes.

Q. And that reflects what we see here, too, this same analysis. You will note on the top of the page it notes that traditional generating stations use only 35 per cent of the fuel.

A. Essentially, yes.

Q. Yes. It also notes, if you look at the second column, cogeneration gives us the opportunity to use about 85 per cent of the energy rather than 35 per cent of the energy.

Do you have any basis upon which to dispute that assertion?

A. No.

Q. Okay. I think if you look to the right of that diagram you will see that there is a red piping and a blue piping that's distributed to a number of figures and I think they represent apartments and houses and a large commercial building and perhaps an

institution and industry, I just want you to assume that for now. I believe we can assume that the pipes, the blue pipe delivers cold water to these facilities, the red pipe delivers thermal energy through water to these facilities.

[12:44 p.m.]

This is what is commonly known as a district heating system or district heating cooling system.

Do you know if Ontario --

A. Is it not that the blue could be the return for the hot water?

Q. Yes, sorry.

A. Rather than delivering cold water?

Q. Sorry, You are quite right. Either it can be the return for the cold water, or, in a more sophisticated scenario, there could be four pipes there, one of which delivers hot water and returns it, one of which delivers cold water for cooling and returns it. But there are two scenarios.

Does Ontario Hydro presently provide district heating and cooling to any community in Ontario from its generating stations?

A. Not to my knowledge, no.

Q. On the next page, if you flip the

page over, the brochure describes some of the benefits associated with cogeneration, and you will see the bullet points there: less emissions, savings on fuel costs, local economic spinoffs, price of energy is more stable, more reliable energy supply, better energy security, et cetera.

Do you have any basis upon which to dispute whether these benefits can be achieved if Ontario Hydro was to cogenerate at its facilities?

A. On the economics and reliability I don't know whether the claims are universal anywhere in the world. You can have economics and reliability equal to other forms of energy.

I think our studies and knowledge of the business of district heating shows that it depends very much on what the alternatives are, the density of the housing and population in a particular area, and many other factors.

Q. Correct.

A. So I think these are not universal conclusions.

Q. I will agree we that. Have you studied the application, the economics of the application of district heating and cooling in Ontario?

MR. DAWSON: A. Yes, we did some years

ago, quite extensively.

Q. What year was that?

A. It was around 1979.

Q. Have there been any studies since that date?

A. Not that I am aware of.

Q. Okay. So, in effect, Hydro's evidence on this issue dates from 1979?

A. '79, early '80s, yes.

Q. Okay. Thank you. Well, then, I guess I throw my question back to you, Mr. Shalaby. Do you have any present basis for disputing whether the benefits listed here could be achieved by Ontario Hydro now or in the future if Hydro was to cogenerate as its utilities?

MR. SHALABY: A. We found in the early '80s and late '70s, as Mr. Dawson is saying, that cogeneration of heat for district heating purposes is not a viable option for Ontario, and, if anything, the price of fuel has gone down since then. Oil and gas prices have gone down since that time, so I think the conclusions carry to this day.

Q. But I guess we conclude also that that wasn't updated for the purposes of the Demand/Supply Plan or Update; correct?

A. That is correct. It was not updated, but I am bringing to your attention the fact that one of the major comparative factors is what the costs of heating by gas and oil are, and the costs of heating by oil and gas have gone down since that time.

Q. Okay. I don't suppose you could undertake to provide those studies to me and any follow-up information that Hydro might have undertaken with respect to district heating and cooling?

A. I am wondering whether any of that is in interrogatory responses. If we can locate them in interrogatories we will bring them to your attention.

Q. Certainly. That would be acceptable.

A. Thank you.

Q. I note that if we go back to the diagram - again, I don't know, Mr. Shalaby, if you are the best person for this, but correct me if I am wrong - on the left-hand side of the page, second column, bottom paragraph, the document asserts that: the greatest savings and efficiency are still obtained from converting large, conventional generating plants to cogeneration.

A. And your question is...?

Q. I take it, do you have any basis other than what we discussed before for refuting that

statement?

A. I think what we discussed before, I think it is a factor -- it is the very specific proximity of a plant to high density population, ease of distribution, of heat energy, the cost of other alternatives.

Q. Based on Hydro's data from approximately ten years ago?

A. Yes.

Q. Thank you. Finally --

A. I think -- we also want to make clear that this document is prepared by the Executive Committee for District Heating and Cooling, so it is not surprising that they are advocating the system and are bullish on its benefits, I would think.

Q. Fair enough. If you could flip the document over to the next page, then, you will see some charts there that discuss reduced emissions that are possible from cogenerating a generation station in this mode.

There is one for coal, one or oil, one for natural gas. I will just refer you to the coal scenario. I think, although it is not clear, if you look at the CO(2) emissions drop the red indicates a generation station operating in a traditional

electricity-only mode and the blue and green indicates a generation station operating in a cogenerating mode, and it would appear that the CO_2 emissions drop from approximately 3 million to approximately 2,225,000. That is a difference of 725,000 or approximately a 25 per cent decrease in CO_2 emissions.

I guess my question again is: Has Hydro studied the ability to drop CO_2 and related emissions through cogenerating?

A. We acknowledge that cogeneration results in less CO_2 emission per unit of electricity produced.

Q. Do you know what percentage of savings of emissions would be at any of the generating stations in Ontario if cogeneration was to be installed or utilized at those stations?

A. Not in detail, no, but it depends on the extent to which heat is extracted, at what stage in the turbine. Yes.

Q. Have you undertaken any of those studies to determine what the emission savings would be for any of the generating stations?

A. Not to my knowledge.

Q. Thank you.

MR. SMITH: A. I think it is clear,

though, that the emissions don't change at the station; it is the emissions per energy unit, and a lot of it would depend on what it replaced, assuming we are not building a new use of energy here. So if it replaced natural gas heating in homes, then I am not sure how that would play out, but I think the answer that we don't have a detailed study of it is true.

Q. You don't know the details?

A. That is right.

Q. However, if it was to replace electricity supplied to Hydro for housing it would relate to an overall emissions drop?

MR. DAWSON: A. Would you repeat that statement?

Q. Sorry, if you were to cogenerate to houses that Hydro presently heats through electricity there would be an overall emissions drop?

MR. SHALABY: A. In all likelihood, yes.

Q. Correct?

A. Yes.

Q. Thank you. Does Ontario Hydro presently cogenerate at any of its thermal generating stations? And I guess specifically I will lead you to it. I am looking at the Bruce Nuclear Power Development. I don't know who would best be to talk to

that issue.

MR. DAWSON: A. We do cogenerate at Bruce to the extent that we supply steam to the Bruce power development, yes, and I think a little bit of Pickering because we supply - now, I had better be careful here, I am not sure - but at Pickering we supply warm water to a fish farm, too. I am not sure whether we actually extract steam to do that or whether we are simply taking warm CW discharge to do that. I forget.

Q. To keep the fish warm at Pickering. Yes, I am familiar with that.

I would like to focus on the Bruce Nuclear Power Development for now, if I may, and I would like to direct you to a second exhibit, which I think we should mark, which is entitled "Steam From Ontario Hydro".

Now, there are two versions of these I have circulated. In the original it is colour, but the cost of colour reproduction is so excessive that I only produced a few of these and the rest of them are regular photocopies.

THE REGISTRAR: Next exhibit number is 512.

---EXHIBIT NO. 512: Brochure entitled "Steam From Ontario Hydro".

MR. POWER: Q. Just by way of knowing what the original format was, you will note that this was originally in a jacket format (indicating), a little map with some information on the inside which has been reproduced as the top four pages on the photocopy in front of you, and that included three insertions which have also been reproduced in the photocopy in front of you, and we will walk through each of those in turn.

I take it, Mr. Dawson, I should address these questions to you?

MR. DAWSON: A. Yes, would you have a spare copy of that brochure? We can use this one.

Q. Sure. Thanks. As I indicated the top four pages were the jacket for this. I don't know whether you have had an opportunity to review this, Mr. Dawson. Have you?

A. No, I haven't.

Q. Well, again I guess I will try and walk slowly through this.

Would you agree this document is published by Ontario Hydro?

A. It certainly has the Ontario Hydro

logo on it, so I think that is a fair assumption.

Q. We can assume that? I guess you haven't had an opportunity to review the document, but would you agree for now that the document addresses the sale of steam from Ontario Hydro?

A. That the document...sorry?

Q. Addresses the sale of steam from Ontario Hydro?

A. Right.

Q. Okay. Well, again because you haven't reviewed it, there is no mention to district heating and cooling from what you can tell on the cover, and I think you will agree after you review this the document doesn't address district heating and cooling at all, but if you find otherwise please correct me.

I believe the document was originally published in about 1984. Do you know if that was accurate? Do you have any sense?

A. I wouldn't know. I haven't seen the document before.

Q. Right. Unfortunately, it is not dated, but --

MR. SHALABY: A. I seem to recall that it could be about of that vintage, yes.

Q. Thank you, Mr. Shalaby.

A. Those were the days we could afford to print nice brochures.

Q. Yes. What I would like to do is -- I don't know, Mr. Chairman, whether this is an appropriate place to break or not, give the members an opportunity to skip through some of the materials over lunch...

THE CHAIRMAN: Probably a good idea. So we will stop now and come back at 2:30.

MR. POWER: Thank you, Mr. Chairman.

THE REGISTRAR: Please come to order. This hearing will adjourn until 2:30.

---Lunch recess at 12:55 p.m.

---On resuming at 2:33 p.m.

THE CHAIRMAN: Mr. Power?

MR. POWER: Thank you, Mr. Chairman.

Q. I guess, Mr. Shalaby, I am going to continue to direct questions at you until you suggest that I wander off to somebody else or somebody jumps in.

Have you now had an opportunity to look at this brochure, which was Exhibit 512?

MR. SHALABY: A. Why don't you ask us questions about it, and we will see whether we...

Q. Okay. Fair enough. If you could turn down to - unfortunately, they are not numbered - it would be the twelfth page.

THE CHAIRMAN: Perhaps you could identify how the page starts off or what is on it?

MR. POWER: Yes, Mr. Chairman. At the top of the page it states: "Low cost steam will help keep your operating costs down...", and some other stuff.

MR. SHALABY: Yes, we have that page.

MR. POWER: Q. Thank you. The brochure states at the top centre column, if I may quote here:

> The necessary modifications to a power station steam system will be made when a customer's steam requirements are confirmed.

Is this still the policy of Ontario Hydro?

MR. SHALABY: A. I don't know. I don't know if anybody else here...

MR. DAWSON: A. I don't know, but I don't see why it wouldn't be.

Q. I don't suppose you could undertake to find out, then?

MR. SHALABY: A. My understanding is that the sale of steam from our stations was expected

to be a big business area in the mid-'80s, but the facts have turned differently.

Only the Bruce energy centre has taken off with multiple customers. But it wasn't simple to line up customers for other generating stations. So I don't know whether we are actively pursuing other customers at other stations, but at the Bruce that is certainly the policy.

Q. That is sort of a side issue. I will leave the Bruce aside for now, but I am just wondering about the business relationships that Ontario Hydro would enter into with prospective customers.

I just note here that it states that: Necessary modifications to the generating station's steam system will only be made first when the customer is confirmed and commitment is up front. I am just wondering whether that is still a precondition of Ontario Hydro being willing to cogenerate at its stations.

A. The precondition meaning having a commitment from a customer to take on the steam?

Q. Yes.

A. I don't know for a fact, but I would expect that would be the case. We will not go and alter our station before we know we have a major

commitment from a purchaser to buy that steam.

Q. Okay. Thank you. The paragraph then goes on to note that: The cost of modification would be included in the general contract negotiations.

Is this still the business policy of Ontario Hydro?

A. See, again I would say that this brochure was produced by our new business ventures division, which explores businesses that Ontario Hydro can be of benefit to our customers, other businesses other than being generation of electricity.

Whether they have policies as such, when you say "this is a policy of Ontario Hydro", I think it is more a business practice that the division is expected to follow in making steam contracts with customers.

THE CHAIRMAN: Did I understand you to say a moment ago that the only people you sell steam to now are at Bruce; is that right?

MR. SHALABY: To my knowledge, that is correct.

THE CHAIRMAN: And do you know whether you are actively seeking steam customers at other generating stations?

MR. SHALABY: I think less vigorously

than we were in the mid-'80s. We used to have a unit dedicated solely to the steam marketing business. To my knowledge, that is not -- we found out it is not as big of an opportunity as we thought it would be.

THE CHAIRMAN: But if someone came along to you with a proposition you would consider it?

MR. SHALABY: Yes.

THE CHAIRMAN: And if the economics were there you might proceed with it--

MR. SHALABY: Yes.

THE CHAIRMAN: --no other adverse factors being involved?

MR. SHALABY: Yes. We always thought it is great idea; we just didn't find the market for it in other locations outside the Bruce. But if customers come along I think we will take them up on it.

MR. POWER: I think I will explore some of the details of the marketing of this. This might help assist.

THE CHAIRMAN: All right.

MR. POWER: Q. But anyway, I believe we will have to conclude for now, based on this document, the cost of the modifications to the generating station would be included in the general contract negotiations. It is certainly a potential --

MR. DAWSON: A. I think that would be a principle that we would tend to adhere to, yes. We wouldn't expect the electrical consumer to pick up the cost of capital modifications that were required to sell steam. You would expect the steam customer to do that.

Q. Right. Okay. Thank you.

I also note that two paragraphs below that it notes that: Any lost electricity production resulting from going into cogeneration will form the basis on which the steam prices are calculated.

I assume that is also the business practice of Hydro, that also would be calculated into any contract for steam?

A. I would think that would be the case, yes.

Q. Thank you. Well, it sounds like, then - and correct me if I am wrong - what I gather from that is Ontario Hydro other than at the Bruce will not provide steam without committed users first being in place and without having committed users who are willing to negotiate and pay for not only the cost of the steam but also the cost of modifications to the facility as well as any lost costs through electricity.

MR. SHALABY: A. Recovery of costs is a

principle, yes.

Q. Right. So the first hurdle is business has to approach Ontario Hydro. The second hurdle is there is a large upfront potential cost that a potential client would have to look at, modifications to the plant, et cetera?

MR. DAWSON: A. I don't think we have said there is a large upfront cost. It may be rolled into the price of steam so that we recover it over a given period of time.

Q. In that scenario we could roll it over.

I take it, though, from the brochure that the emphasis is on the prospective purchasers of the steam approaching Hydro first to initiate discussions?

MR. SHALABY: A. I think I said that in the mid-'80s we were aggressively seeking customers.

Q. Right.

A. My knowledge, that we are not as aggressive in seeking customers at this time.

Q. Well, perhaps we can turn to --

A. I may be wrong in that, but I just don't see the advertising that we used to see in the mid-'80s.

Q. Right. The advertising has

dropped -- I think if you turn to Interrogatory Response 8.15.15, which I think is attached to the materials in front of you...

[2:40 p.m.]

THE REGISTRAR: That is 475.34.

---EXHIBIT NO. 475.34: Interrogatory No. 8.15.15.

MR. POWER: Q. You will note in the response in the second paragraph, it states that Hydro has pursued the recovery of thermal energy when commercial opportunity prevents itself.

Again, I take it from this document that Hydro is sitting in a passive mode, at least presently, waiting for business to approach it.

MR. SHALABY: A. I don't know whether to characterize it completely as a passive mode. I would say we are not as aggressively seeking the business in terms of advertising.

We identified potential users in the mid-80s, we approached a large number of industries within a certain proximity to our plants, we made them aware of the steam services that we can provide and the terms and conditions under which we can provide the services.

So I think there is a large customer base around our plants that is aware of the potential for

using steam, and if their conditions change in a way that they can come back to Hydro, we will discuss that with them.

Q. I guess there is a question of how you market it, but I will get back to that in a minute.

Is there an incentive program available for any prospective purchasers of steam? Is there an incentive program in place?

A. is there an incentive program in place for...

Q. For prospective purchasers of steam?

A. I am not aware of the details of that. I think there may be but I don't know about it.

Q. You not do know whether there is a program available.

A. I don't know.

Q. Are there any estimates of what it would cost a prospective purchase to purchase steam from the generating stations?

A. There is a chart in here, I think it shows it to be $2 per million btu, and that was...

THE CHAIRMAN: In Exhibit 512?

MR. SHALABY: In 512, you're right, Mr. Chairman.

MR. POWER: Q. Do you know if that

includes the cost of modification as well as the cost of any electricity lost?

MR. SHALABY: A. I don't know what that includes, I'm sorry.

Q. Thank you.

A. Mr. Dawson is alerting me that this was for Bruce. The price may be different at other places.

Q. Thank you.

MR. DAWSON: A. That was study done in 79 where we looked at all our thermal generating stations and calculated the price of steam from virtually every possible extraction that was available on the basis of the cost of replacement energy.

Q. Yes.

A. I am trying to think whether in fact -- I don't think we estimated the capital costs of reboiler equipment. We certainly looked at the value of the thermal energy that could be taken out of the existing turbine and what in fact that was worth to Ontario Hydro in terms of derated output, and so on.

Q. So based on that, then the purchaser could find out what the cost of steam would be, but in terms of the specifics of any modifications to the generating station, that would have been to be explored

with Hydro, those details.

A. That's right. And that would depend on the size of the steam load and so on.

Q. A variety of specific factors.

A. Yes. But we did develop the methodology for pricing the steam.

Q. Right. If you turn to the next page you will note that the top left-hand column of the page, it states Darlington Nuclear Station, and I think the remainder of these pages go on to describe station by station some of the opportunities.

I note that for Darlington in the description in the bottom paragraph, it states that studies are now being done to identify a site suitable for a development as an industrial park and to assess larger economic impact.

Are you aware of this study, Mr. Dawson, I guess?

A. No, I wasn't aware of that study, no.

Q. Thank you. I think we will be getting back to that in a minute.

Now, if you could please turn down a further five pages you will find that a new document starts called the Bruce Energy Centre, which addresses the details of the steam provided to the Bruce Energy

Centre. If you carry on another three or four pages after that you will find a photocopy of a page where it only has typing on the one side, the heading at the top of the page is Bruce Steam: An Outstanding Business Opportunity.

At the bottom of the page for that document it says page 3.

A. Right.

Q. Now, this gets into the specifics of the delivery of steam from the Bruce Energy Centre; correct?

A. Yes.

Q. I believe at the time that this document was produced, it was prior to the actual building of the Bruce Energy Centre. I just raise that because some of the language is tentative and future-looking.

I believe that there is no dispute that the Bruce Energy Centre is in place and that there is a pipeline going from the Bruce Nuclear Power station to the Bruce Energy Centre. So with that in the background, it states in the very bottom of that page that the steam delivery system is capable of delivering 115,000 kilograms an hour to the Energy Centre, or up to 500,000 pounds an hour at a lower pressure.

Do you know if that's still accurate?

A. I have no idea.

Q. Okay. If you back up, I believe that's only from the one pipe that's in existence between the generating station and the Bruce Energy Centre.

A. Yes, I wouldn't know. I haven't any idea.

Q. If you can turn to the next page which states page 4 at the bottom of the page, there is a sub heading entitled Site for Bruce Energy Centre. The second paragraph, it notes that Ontario Hydro has submitted an environmental assessment to the Ministry of the Environment.

Do you know if Ontario Hydro has undertaken like environmental assessments for any of the other thermal generating stations in Ontario?

DR. EFFER: A. No.

Q. Thank you.

There is a further subsection down there that states land prices. It notes that lots will be sold or leased to customers apparently from Hydro.

Are you aware that Hydro did in fact own this land prior to the park being developed?

MR. DAWSON: A. I'm not sure who owned

that land. It was a rather complicated deal and I was never involved in the details, so I don't know.

THE CHAIRMAN: Aren't we straying a little bit away from fossil generation?

MR. POWER: Well, that is a good point, Mr. Chairman, I appreciate your concern.

I guess what I am trying to look at is the delivery of thermal energy either as maximizing fossil generation or as an alternate energy form. I frankly don't know which way to look at it, it depends on how you approach the issue. And within that I am trying to look at the Bruce Energy Centre is obviously an example of where it has worked, I want to determine why it has worked there and try and apply it generically to other stations. I don't need to get into the specific details too much.

THE CHAIRMAN: I think as long as you stick to that. But if we get very particular about the pros and cons of the Bruce thing, that's getting a bit site-specific.

MR. POWER: I agree. But my only point, Mr. Chairman, is that the reasons for the success at the Bruce Energy Centre is because Hydro put in a lot of up-front effort and they haven't put an up-front effort at other generating stations. That will be my

assertion. If you can permit me to follow that line of questioning.

THE CHAIRMAN: Certainly.

MR. POWER: Thank you.

Q. The next page, at the bottom of page --

THE CHAIRMAN: What we are going through now is a selling document. I don't know if you need to go through the document that way. You could perhaps ask the questions, if it's not too difficult to do, in a general way and perhaps you will get more helpful answers.

MR. POWER: I guess I would assume the knowledge of the panel member who is familiar with the details of the Bruce Energy Centre and to be honest I don't know if that exists.

Q. Is somebody intimately familiar with the details of the Bruce Energy Centre, how it was developed, the background to negotiations?

MR. SMITH: A. I don't think we have anyone who has that expertise.

One thing I can say, though, when you talk about Hydro promoting it and putting the money upfront, the difference between that particular site and any other site that is in this brochure was that

the first four units at Bruce had more steam producing capability than their reactor size to use all the electrical output, or use all the steam to make electricity, and therefore there was a surplus of steam.

Q. Right.

A. The "B" plant does not have that and I don't understand that the Darlington plant has that, and as we have just had testimony from Mr. Dawson, all the coal plants would in fact have a reduction in the electrical output if we diverted the steam to other uses, so there was a distinct difference.

Q. I was just looking at one example, Mr. Smith. Thanks.

MR. DAWSON: A. Not only that, there was also the capital investment made in the steam transformer plant in Bruce for other reasons for the heavy water plant, so that already existed too.

Q. I guess the essence of my point is that Ontario Hydro had a sunk capital cost, Mr. Dawson, but they found a way of maximizing some excess energy at that site; didn't they?

A. I think that's a fair statement.

Q. And in maximizing that excess energy they put some capital cost upfront to provide that

service, thermal energy, to industries located nearby; correct?

A. In the sense that they built a pipeline, but I am not sure who actually funded the pipeline, I don't have that knowledge. The pipeline was built, that's for sure.

Q. Correct. Do you agree that through providing this excess energy to the Energy Centre nearby, that this has created a local economic positive benefit, if I may?

A. Yes, there have been a number of industries developed on that site, yes.

Q. Thank you.

We will get into it a bit later, but I understand there are now four industries located at the Bruce Energy Centre; is that correct?

A. That's my understanding, yes.

Q. Thank you.

On the bottom of page 12 of that document -- sorry, page 12 is listed on the bottom, there is a subsection called The Bruce Bulk Steam System, and it lists five different ways that the bulk steam system provides steam for various uses other than electricity, or more accurately, in addition to electricity.

Would you agree, Mr. Dawson, that essentially the generating station is therefore producing thermal energy and electricity at the same time?

A. Yes.

Q. Thank you.

I think one reason, just to be fair to Mr. Smith, that he raises, because there is excess steam due to the specifics of that site, but my point is that they are certainly cogenerating and maximizing excess steam.

If I may turn now to the next document. It's a small document entitled Nuclear Problems Tackled.

We should mark this as an exhibit as well.

THE REGISTRAR: That will be No. 513.

---EXHIBIT NO. 513: Document entitled Nuclear Problems Tackled.

MR. POWER: Q. Mr. Dawson, do you have a copy of that in front of you?

MR. DAWSON: A. Yes.

THE CHAIRMAN: Who is the author of this document?

MR. POWER: That's my next point, sir. I

have never seen the original, I have only ever seen a photocopy, but I think if you look at the back of this document it has Ontario Hydro's name on it. I just wanted to confirm whether anybody on the witness panel knew for a fact whether this was an Ontario Hydro document.

MR. HOWARD: It's also possible, it seems to me, it was an ad that was in the magazine from which the article was taken. It's reprinted.

MR. POWER: Yes, it appears to be reprinted by Ontario Hydro. I don't know.

Q. Does anybody on the witness panel know? Are they familiar with this document?

MR. SHALABY: A. No, I don't believe so.

Q. Well, I am not sure whether we can assume who published this, but if I may I would like to proceed to the details in any event.

Mr. Dawson, did you have an opportunity to review the document over the lunch break?

MR. DAWSON: A. I didn't read this document over the lunch break. I did look at it last night briefly. But I didn't go into it in a lot of detail.

Q. It's a document that relates to the Bruce Energy Centre and its relationship with the Bruce

Nuclear Power Development; correct?

On page 2 there is a sub heading up there Temporary Bruce "B" Heating Steam, and about three quarters of the way through that paragraph it just notes that through providing the steam heat on-site Ontario Hydro had savings in fuel oil heating costs for the '80/81 winter of approximately 320,000.

That savings was achieved by the cogeneration of the thermal energy to that site; wasn't it?

A. This appears to be the case, yes.

Q. Thank you.

Under the sub heading steam supply in the middle of that document, third paragraph, the document states that the original plan was to construct a second stage to the industrial park, that being the second stage of pipe, as soon as letters of intent were obtained from a customer or a group of customers, however, it continues, as this proved an impractical approach to marketing, it was decided to prebuild a further three miles to the Bruce Energy Centre.

It would appear, based on this document, that Hydro attempted to get committed industrial users upfront but found that that didn't work, and then in fact they decided to initiate the effort, if I may, by

the building of the pipe to the Bruce Energy Centre.

Are you familiar with that, Mr. Dawson?

A. I'm not really familiar with any of this. I wasn't directly involved in any of this.

Q. Nobody on the witness panel is?

Well, the document certainly concludes that Hydro had to initiate the effort first before the purchasers would invest.

If you will turn to the next page under the sub heading, bottom centre, Other Steam Supply Alternatives, there is a description of Darlington. The description notes that a provision for steam take-off has been included in the Darlington design, however, it notes that the studies have been undertaken which have found that it is not feasible until 17 to $20 million is made available from sources other than Ontario Hydro, or, it goes on, if there is an upturn in the forecasts of natural gas.

Are you familiar with this study, Mr. Dawson, in light of the 1979 reports?

A. No, I am not.

Q. Is anybody else on the panel familiar with this?

MR. SMITH: A. No.

Q. I suppose you could undertake, Mr.

Dawson, to find any report that may have found this, concluded this?

MR. DAWSON: A. To find a report that deals with what precisely?

Q. That the feasibility of providing steam from Darlington and the capital cost outlay estimate of 17- to 20 million.

A. So you are asking me to substantiate the 17- to $20 million number with a report or whatever documentation there is?

Q. IF Hydro happens to have it.

A. Yes, I can try to do that, yes.

Q. Thank you.

THE CHAIRMAN: That will be an undertaking now, I guess.

MR. POWER: Yes.

THE CHAIRMAN: 478?

THE REGISTRAR: 478.29.

---UNDERTAKING NO. 478.29: Ontario Hydro undertakes to provide a report substantiating the feasibility of providing steam from Darlington and the capital cost outlay estimate of 17- to $20 million.

MR. POWER: Q. You would agree Mr. Dawson, that based on this statement, it appears that Ontario Hydro would not build an industrial park at Darlington unless somebody else first put up the

necessary funding to build the necessary steam delivery system?

MR. DAWSON: A. That's what that says, I think, yes.

Q. But according to Ontario Hydro's own documentation regarding the Bruce Nuclear Power Development, Hydro found that industry could not be attracted unless Hydro first built the pipe; is that correct?

A. That's what that appeared to say. I do know that there was a lot of interest in the Bruce Energy Centre. There was certainly one individual by a name of Sam MacGregor, I believe, who had a big involvement in that, though again I don't know what the precise role was, I was never directly involved, but that was a name I kept hearing.

THE CHAIRMAN: Well, it's understood that what was going on at Bruce was an extension of the pipe, it was not the initial building of the pipe; is that right?

MR. POWER: Mr. Chairman, there is no pipe in existence. My point is the customers didn't build the pipe or initiate it. It appears Hydro tried to market the program and --

THE CHAIRMAN: But it was an extension

they didn't do, not the original pipe.

MR. POWER: Oh, it was an extension of the delivery system at the Bruce.

THE CHAIRMAN: It says the original plan was to construct the second stage in the industrial park. I assume the first stage was already in place.

MR. DAWSON: That's correct, Mr. Chairman. There is a steam transformer plant and a steam delivery pipeline to the heavy water plant.

MR. POWER: There is a steam delivery system at the Bruce, but there was no pipe going from the Hydro property to the Bruce Energy Centre prior to Hydro first building it.

THE CHAIRMAN: That may be true, but that's not what this paragraph says.

[3:00 p.m.]

The paragraph that you are comparing Darlington to Bruce with, it says the second extension -- or it says: The original plan was to construct the second stage to the industrial park as soon as the letter of intent was obtained.

MR. SMITH: And the paragraph prior to that mentions the first phase was to build a 1.6 kilometre pipe to serve our central maintenance facility and our training centre, which was on the site

but still an extension of the piping facility.

MR. POWER: Q. Right.

MR. SMITH: A. And then the additional incorporation was just an add-on to that to extend it further.

Q. Well, my understanding is that -- backing up to that paragraph - correct me if I am wrong - in the middle of the second page of that document: The original plan was to construct the second stage to the industrial park. The "second stage" refers to the pipe?

A. Yes.

Q. As soon as letters of intent were obtained, committing to a substantial portion. But, however, letters of intent or a commitment to a substantial portion didn't come forth, and it was only after that time that Hydro then undertook to build the pipe.

A. That is probably essentially the case, yes.

Q. So in the Bruce scenario Hydro took the initiative to build the pipe first and then obtained commitments for the provision of steam?

MR. MEEHAN: A. I think there is a fundamental difference in the two stations. The

situation at Bruce was that we had a very large amount of steam that was going to waste.

Q. Right.

A. We don't have that situation at Darlington. It is my understanding that the electrical generation is sized to the reactors and that if we were to get into a large-scale sale of steam we would be reducing the electrical output at Darlington.

So the incentive isn't at Darlington as it was as Bruce.

Q. I think how you sell the excess steam is a separate issue. I want to get back to the issue Mr. Smith raised earlier. I accept the fact that at the Bruce there is excess steam through the natural generation capability, and it is a very different scenario at Darlington. I am going to get into that in a minute.

MR. SMITH: A. The reality is that attracting industry to locations where they might not necessarily want to be is a difficult exercise, and we obviously at the Bruce felt we had to put the facility in first. Even with the facility in, there are four industries there; it is not exactly, to quote, you said a "success". It is successful for the community because there are four industries there that wouldn't

have been there otherwise, but it hasn't taken up all the capability of that centre at this time.

So from Hydro's perspective, it became quite obvious that we weren't going to get overrun with people wanting to build industry at the end of our steam pipes.

So building any more to promote further industrial development when we couldn't even get people to go to the Bruce site where it really existed was not going to make a lot of sense.

Q. I accept the point --

A. I think that is our position right now as a company.

Q. It is just not economical?

A. We have put out these big promotional brochures and we haven't had anybody beating the door down wanting to develop large industry at the end of our pipes.

Q. Right.

A. Whether they existed or not.

Q. So the issue is economics in attracting users?

A. For someone it is, yes.

Q. Okay. I think there are some other side effects which should be considered though, that

after a major socioeconomic impact of building a large facility and when the large labour force associated with building a large generation station leaves at least providing steam in local industry which works off the steam is a positive socio-economic impact. It leaves a long-term, positive impact for the community, which I believe we agreed to earlier.

A. If industry can be attracted, yes.

Q. Okay. I take it in summary, then, although steam is offered at the Bruce, steam and/or district heating is not offered at any other generating station in Ontario right now that Hydro owns?

MR. DAWSON: A. I think we have said that if somebody comes along and expresses interest in taking steam we will talk about it and try and negotiate something.

Q. At that time?

A. But we are not actively--

Q. Pursuing it?

A. --going out -- or, at least, I don't know that we are actively going out looking for steam customers at any of the other stations.

I think it is worth saying, though, that we are actively trying to promote cogeneration through the non-utility generation program and that we are

offering a premium for cogeneration over other sources of generation.

Q. Thank you, Mr. Dawson. I would like to refer to the next document, if I may. It is entitled "Opportunities for the Cogeneration of Electrical and Thermal Energy by Ontario Hydro", which is Exhibit...?

THE REGISTRAR: 514.

---EXHIBIT NO. 514: Document entitled "Opportunities for the Cogeneration of Electrical and Thermal Energy by Ontario Hydro", prepared by Dr. Rosen.

MR. POWER: Q. It is prepared by Dr. Rosen, and it is an overview report of some of the work undertaken on behalf of South Bruce.

I don't know who to address these questions to. Who had an opportunity to read this? Mr. Dawson?

MR. DAWSON: A. Yes, I looked at it last night again.

Q. Thank you. The document is intended to assess potential opportunities for Ontario Hydro to cogenerate; correct?

A. Yes, that is correct.

Q. If you could please turn to page 3, I just want to walk through a couple of things in the

document.

Page 3, in the middle to bottom part of that document, there are six examples of existing large conventional generational systems which generate electricity and thermal energy at the same time to users.

Do you know if Ontario Hydro is aware of these six examples and whether they have studied it?

A. I wouldn't know whether anybody in Hydro is aware of those six. I am certainly aware of the nuclear plant in Michigan, item 3.

Q. Do you know if --

A. Not in detail, but I know that it exists, and I know that is being converted from a nuclear station to combined cycle, and I know it supplies some steam. Yes.

Q. Are you aware of whether Hydro has studied these examples for possible application in Ontario?

A. Whether Ontario Hydro has studied what? Sorry.

Q. Studied these examples as a basis for comparing whether cogeneration would work also in Ontario.

A. No, I don't know that.

Q. I note then in example number 4 there is a large district heating project being planned for Edmonton. My advice is that this is going to occur very soon, I believe in the next year, although I don't know the details.

Do you know if Ontario Hydro is monitoring this specific program?

A. No, I don't know.

Q. Page 4, there is a sub section, "Electricity Generation". If you go to the paragraph under point 4 that begins with "Overall energy balances for Nanticoke and Pickering stations...", it states:

> The overall station efficiency with electricity only for Nanticoke is 37 per cent and for Pickering is 30 per cent.

Do you agree with those numbers?

A. I'm sorry -- oh, under point 4, "Overall energy balances for Nanticoke and Pickering station are represented in figure 2"?

Yes, I looked at them last night. I didn't find anything to quarrel with, no. I think they are a reasonably close approximation.

Q. Fairly accurate?

A. Yes.

Q. The paragraph then continues with the

line:

By far the largest energy loss is associated with heat rejected from the condensers into the cooling water.

Do you agree with this statement?

A. Yes.

Q. It then continues:

In fact, thermal energy rejected for each plant is approximately 150 per cent to 200 per cent of the net electrical energy produced.

I think rephrased that is 1.5 to 2.2 times the electricity produced.

Do you agree with that statement?

A. Yes.

Q. The paragraph then continues on to say:

Thus, efficiency can be markedly improved for both plants if cogeneration is implemented.

Do you agree with that sentence?

A. Yes.

Q. Thank you. On page 5, last paragraph, it starts out with the line:

A significant degree of flexibility

exists in the current system for utility-based cogeneration.

Do you agree with this statement?

A. Yes, in terms of the quantities and qualities of steam that can be supplied, yes.

Q. Thank you. If you could then turn to page 7, please, the report after assessing the existing system at Ontario Hydro... It then goes on to consider a scenario.

The cogeneration scenario, you will note in the first paragraph, involves the use of heat from utility-based cogeneration network - namely, Hydro - to supply only 9 per cent of the annual heat demand for residential/commercial sector and 6 per cent of the annual heat demand for the industrial sector.

The paragraph goes on to note that the scenario does not include a consideration of further opportunities through cogenerating cooling water for district cooling.

The other point I want to refer you to is at the bottom of the page it also notes:

> In this scenario half of the cogenerated heat is used to offset electricity provided by Ontario Hydro to users for heating. The other half of the

> cogenerated heat is used to offset non-Ontario Hydro energy resources used by others for heating. Accordingly, the scenario assumes that energies in addition to electricity will be displaced.

Is that your understanding of this paragraph, Mr. Dawson?

A. Just repeat the last sentence? I lost it.

Q. The scenario assumes that through cogeneration energies in addition to electricity will be displaced or fuels in addition to electricity will be displaced.

A. Yes.

Q. If you could please turn to page 8 under the "Findings", finding No. 1 finds that:

> Assuming this scenario is put into place there will be an 8 per cent decrease in provincial annual electricity consumption which will permit Ontario Hydro to decrease annual electrical generation by 8 per cent.

This in effect would reduce demand, wouldn't it, Mr. Dawson, assuming this scenario to be accurate?

A. If the scenario is accurate, yes.

Q. It would reduce demand?

A. Yes.

Q. Thank you. Before we go on to the other four points I would then like to refer you to table 3 and table 4 which is attached to that report, which is on page 12 of the report.

Table 3 refers to percentage reductions in energy use, and the first half looks at a base case energy use which is the existing system and then immediately under that it says percentage reductions in value for the scenario.

If you look to the centre under the column "Coal" it notes that:

> Coal use will drop by 20 per cent under this scenario. There will be a fuel savings of 20 per cent for coal.

Do you have any basis to dispute these numbers, Mr. Dawson?

A. No, but I haven't looked at them either. I don't have a basis for--

Q. You don't --

A. --commenting on them at all.

Q. Thank you. But at the same time Hydro hasn't examined how cogeneration could lead to

fuel savings, has it, for the purposes of this hearing?

A. No.

Q. If you go to the far right-hand column, which is "Total Energy Use", it notes that:

For the utility sector the total energy use drops by 13 per cent.

Do you have any basis to dispute these numbers?

A. No.

Q. Then go on to table 4. It addresses the percentage reductions in annual emissions from the base case scenarios.

Again, there is a base case in the first half and then immediately underneath that there is the percentage reductions and values for the scenario. I think if you will go across the utilities sector for SO(2), NOx, CO(2), CO particulates, volatile organics, each of these emissions drop by 20 per cent.

Do you have any basis upon which to dispute these numbers?

A. No.

Q. You don't have any basis upon which to question any of these numbers; correct?

A. That's correct.

Q. Thank you.

MR. SMITH: A. We don't know the

assumption behind the SO(2) reduction so we don't know what plant was assumed and what kind of coal was being assumed at the plant, and so I guess without knowing anything of that we can't dispute it, but I would assume you had to make an assumption about the sulphur level of the coal being used, and therefore, eliminate it from consumption. And therefore, the number would be quite different, depending on what sulphur level you assumed and whether it was a coal scrubbed plant or otherwise.

Q. There are several assumptions in the scenario; correct? Yes.

But assuming that the assumptions in this scenario are accurate I would like to ask a few questions, if I may.

Mr. Meehan, how much did Ontario Hydro pay for coal in 1991? Are you aware?

MR. MEEHAN: A. Maybe Mr. Smith knows.

Q. Sorry. Mr. Smith?

MR. SMITH: A. You mean total dollar expenditure for coal?

Q. Yes, please. Roughly.

A. $700 million.

Q. So a 20 per cent reduction in coal fuel use would be a significant cost savings to Hydro?

A. Yes.

Q. Yes. Assuming there is a 20 per cent reduction in many emissions related to coal this would also result in a substantial savings from reduced fly ash and waste, wouldn't it?

A. Yes.

Q. Dr. Effer, do you agree that this reduction in emissions from reduced coal use would result in a significant public health and environmental savings over the 25 year planning period?

DR. EFFER: A. Any reduction in emissions would have a beneficial effect, yes.

Q. Would you consider a 20 per cent reduction a significant reduction?

A. Yes.

Q. Thank you. Dr. Effer, in the first exhibit which I had referred you to, you don't need to get it out but just by way of memory, Exhibit 511 and the diagram in there where the district heating and cooling is used the waste heat is discharged to the community rather than to the Great Lakes where most of our generation stations discharge to. Likewise, the generating station receives the water back from the community.

Dr. Effer, if generating stations in

Ontario Hydro cogenerated in this manner and did not need to receive their cooling waters from the Great Lakes, I believe you would agree that the reduced fish mortality and related aquatic effects caused by the cold water intake and the discharge systems at thermal generating stations would be reduced or eliminated?

A. Are you saying we would dispense with once-through cooling?

Q. Yes.

A. If we dispense with once-through cooling what would we use for cooling the...? Would we use cooling towers?

Q. Either use cooling towers -- what I am suggesting is that if you district heat to the community you use the community as the condenser or as the cooling.

A. I think the amount of district heating or cooling that you would need would be quite large in order to dispense with some form of cooling system.

Q. Assuming that, that district heating was in place, it would certainly lead to an elimination of the aquatic effects, environmental effects in the water?

A. If under whatever system was adopted

there were no discharges to the lakes, obviously there would be no adverse effect, but there would be some small amount. There would be some discharge necessary from the system. I am not sure that it would be a completely zero discharge system.

Q. As a general rule, I guess if we are going to reduce our intake and our exhaust there would likely be an associated reduction in the environmental effects?

A. Yes. We do know the thermal effects are not quite as dramatic as you have mentioned about fish kills.

Q. I was thinking more of on the intake fish being killed.

A. Entrainment effects, yes.

Q. Yes.

MR. DAWSON: A. I think you should realize that at Nanticoke, for instance, based on your own evidence, you are looking at an 8,000 megawatts thermal discharge out of the back end. That is an awful lot of district heating. There is nothing around Nanticoke that could absorb that sort of heat.

Q. That is one scenario, but I assume that if you had a generating station located near a large industrial and residential site you would have

the potential to deliver that heat energy.

A. Yes. Right now we are talking about what is already there, and, in fact, you couldn't modify what is already there to use that--

Q. True.

A. --back end heat. We can look at extraction steam, but we can't look at using the entire exhaust from the 4,000 megawatts of generation.

Q. Are you stating that you cannot retrofit an Ontario Hydro generating station to provide district heating and cooling to the area?

A. No, I am not saying that. I am saying that you can't dispense with a condenser entirely though, because all you can take is extraction steam that is currently being used for feed heating--

Q. I think I will leave that.

A. --without an enormous investment in modification costs.

[3:20 p.m.]

Q. Correct.

Mr. Dawson, I believe in Exhibit 473 - we don't need to refer to, but just to refresh your memory - you refer to the intake and discharge system that's put into place at Darlington. The intake system is about the size of a football field and you mention

that the dispatch pipe is approximately a tunnel of roughly 30 to 40 feet in diameter, if I remember correctly.

Do you know what the total cost of this intake and discharge system would be?

A. No, I don't.

Q. I suppose you can undertake to provide that.

A. I can tell you it was less than the previous design that we had, but I don't know what the total cost was.

You want me to provide it?

Q. Please, yes.

A. I will do what I can. I am not sure.

THE CHAIRMAN: 478?

THE REGISTRAR: 478.30.

THE CHAIRMAN: That's the cost of the Darlington intake system.

---UNDERTAKING NO. 478.30: Ontario Hydro undertakes to provide the cost of the Darlington intake system.

MR. POWER: Q. Mr. Shalaby, I believe Ontario Hydro has committed $6 billion to the demand management program. Is any of this money committed to cogeneration? I don't believe it is. Is that correct? Do you know?

MR. SHALABY: A. Mr. Dawson and all of Panel 5, they described Hydro's initiatives and commitments to cogeneration, industrial cogeneration that is.

Q. But it does not address district heating for which funding from the demand management program will be allocated; does it?

A. I believe Ms. Fraser in Panel 4 mentioned a funding for a district heating system in Kingston and there was an undertaking to be provided on that subject. So there are small amounts of money for district heating, for example, studies on district heating.

Q. There is money committed for studies only?

A. At this time that is the case.

Q. Thank you.

Mr. Shalaby, I guess I am winding up, you would agree with me that the Demand/Supply Plan does not refer or consider the utilization of cogeneration anywhere in meeting demand or in reducing demand in the next 25 years?

A. If you mean cogeneration from our own stations--

Q. Yes.

A. --you are correct.

Q. And then the update there is likewise no reference?

A. You are correct.

MR. POWER: Mr. Chairman, this completes my questions on cogeneration. As I indicated earlier, I am still awaiting a report, if you don't mind I prefer to leave the remainder of my cross-examination until, it looks like, tomorrow afternoon.

THE CHAIRMAN: Let me just clarify that. There is only one other cross-examiner left, and so if you are going to do it, it will have to be after that or not at all.

MR. POWER: I understand, Mr. Chairman, I will be here.

THE CHAIRMAN: Thank you, Mr. Power.

MR. POWER: Thank you.

THE CHAIRMAN: Now, we have the Government of Ontario next. I don't see any of their counsel here.

MS. MORRISON: They are just coming.

THE CHAIRMAN: Would they prefer we take a break and we will come back after?

We will make a 15-minute break.

THE REGISTRAR: Please come to order.

This hearing will recess for 15 minutes.

---Recess at 3:25 p.m.

---On resuming at 3:40 p.m.

THE REGISTRAR: Please come to order. This hearing is again in session. Be seated, please.

THE CHAIRMAN: Mr. Moran?

MR. MORAN: Thank you, Mr. Chairman.

Just a preliminary note, Mr. Chairman, Mr. Thompson a couple of days ago referred to the Detroit Incinerator case and I just wanted to confirm that the Government of Ontario is in fact a co-plaintiff in that place. It's a civil proceeding; we are not Intervenors. It's a process that started several years ago under the liberal administration and has continued up until now, and won't be over probably for another year or two, I'm sure.

THE CHAIRMAN: Okay.

MR. MORAN: As an outline of our cross-examination, our intention is to deal with alternative technologies first, and that will probably take at least the rest of today. We will then move on to specific issues relating oil, gas and coal, and looking at environmental impacts relating to those three options, and then we will finish up with various comparison of the options, issues relating to

comparisons, and that should complete it. We feel we will probably finish tomorrow.

Q. I have handed up to the Registrar a paper of two pages. I am not intending to make this an exhibit. What I have done is extracted from Exhibit 74 various strategic elements contained in Exhibit 74. Exhibit 74 is the Demand/Supply Planning Strategy, and just for convenience of reference I gathered some of the elements in there. I will refer all the way through to Exhibit 74 and to the numbers in there rather than make this piece of paper an additional exhibit.

CROSS-EXAMINATION BY MR. MORAN:

Q. Mr. Shalaby, in Exhibit 344 various technologies have been dealt with there and have been described as being alternative technologies, and I note specifically in relation to photovoltaic and wind technologies, that these are described are described as technologies that are well developed and widely used in other jurisdictions. I assume that when you refer to these as alternative technologies it's in the context of Ontario alone as opposed to something inherent in the technology itself?

MR. SHALABY: A. We discussed the meaning of why we call them alternative, we discussed

that. In the main you are correct, yes.

Q. Essentially, it's because Ontario Hydro doesn't actually use these technologies at this point, that they are actually referred to as alternative technologies; right?

A. We are open to suggestion on what to call that collection of technologies. If somebody can come up with a more descriptive, more meaningful, we will adopt it.

Q. Turning to photovoltaics to begin with, and as I already stated, these are well established and widely used as described in Exhibit 344, the alternative energy review, I would like to draw your attention to page 3 of that exhibit at this point. In the left-hand column, almost halfway down there is a paragraph just before the first bold heading, the DSP also stated that:

> Hydro will continue to do research and development on many generation concepts which have promising applications. Hydro is also keeping abreast of research and development by others and is ready to respond if a major technological breakthrough occurs.

And there is some references that follow.

In the context of photovoltaics, I was wondering if you could indicate how many research and design people at Ontario Hydro are actually working on photovoltaic technology at this point?

A. Perhaps three people full-time, or most of their time is give to photovoltaics. And many others in a peripheral way, people who handle, for example, purchasing orders or handle processing of research grants, or meetings with the universities on dispensing for research money. So there are many others that have peripheral involvement. But if you like as experts and people who have main involvement, I would say two or three.

Q. These two or three people, what is the specific nature of their work, are they actively doing research on photovoltaic, or are they involved in tracking matters in other jurisdictions and in the literature? What is the nature of the work they do?

A. Being small in number they really cover the whole landscape. They look after demonstrations, some people at the research labs, the Kipling Research Laboratories are more concerned with basic research to do with photovoltaics, the design and development people are more concerned with

demonstration and following activities with other utilities.

Q. Is it fair to say then that there is very little actual research being done on the photovoltaic technology?

A. It is fair to say that.

Q. By Hydro?

A. Yes.

Q. Are you able to give any estimate of the research budget that is allocated to photovoltaics?

A. We indicated to previous intervenors that something like $450,000 for alternate energy program.

THE CHAIRMAN: It's gone down 50,000 since this morning.

MR. SHALABY: Well, the previous intervenor got a bigger deal than this one.

MR. MORAN: They are using them up faster than we thought, Mr. Chairman.

MR. SHALABY: And some more money for the design and development people.

So roughly a million dollars for all the alternatives, design development and alternate energy research, and we detailed that in some of the interrogatories that we referred to this morning. That

is not just solar photovoltaic, that is all the alternatives combined.

MR. MORAN: Q. Given what you have said, that there is very little research being done on photovoltaics per se, I would like to draw your attention to the transcript Volume 109, that's in the direct evidence, at page 19100.

MR. SHALABY: A. Yes.

Q. Beginning at line 13 on that page, you indicated in your direct evidence:

> We also wanted to know what the performance of these technologies might be in Ontario. A lot of the information on alternate technologies that is in the common literature and scientific literature would often refer to what the performance is California, for example, or in Finland or places like that, we wanted to transport that experience to the extent we can to Ontario and make conclusions that are appropriate for Ontario.

In that context, if very little actual research is being done in Ontario by Ontario Hydro, how do we achieve the objective as set out in your direct

evidence?

A. I think those objectives are not necessarily achievable only by basic research. Literature surveys, participation, industry working groups, discussions with manufacturers, discussion with other international agencies and organizations, there are other ways of gaining knowledge in addition to basic research, and the years of experience that we have had in these areas, we want to apply that data available elsewhere and try and project how the technology will perform in Ontario.

Q. Would that include projects like the Sunnybrook Hospital project as an example?

A. That is just under way but when that is finished that would be the case.

Q. That will be an example of what you are suggesting?

A. Yes.

Q. Okay. Now, as I understand the purpose of that project, just to spend a little bit of time on it, it's being designed as summer peaking load reduction at the hospital; is that correct?

A. That's my understanding.

Q. In fact, Toronto Hydro is a summer peaking utility; isn't it?

A. To my knowledge, it is, yes.

Q. In fact there are other municipalities in Ontario that are summer peaking as well, aren't there?

A. Yes, and we provided a list of those in different panels, yes.

Q. And this is it despite the fact that Ontario Hydro as a whole is a winter peaking utility?

A. Yes.

Q. Now, you have indicated in your Exhibit 344 that photovoltaics are suitable for niche applications. Would the Sunnybrook Hospital project be an example of a niche application?

A. It's certainly an emerging wider niche than the previous applications, that photovoltaics have found wider application. It's a new application, shaving air conditioning load or summer cooling load. The issue here is we want to demonstrate whether that in fact is a workable and perhaps could be an economic proposition in the future.

Q. Given the nature of Toronto Hydro as a peaking utility, theoretically you could treat Toronto as a niche in the context of the province, right? Given that it is summer peaking while the Ontario utility itself winter peaking?

A. A summer peaking utility is different than a winter peaking utility, is that the distinction you want to make?

Q. In fact, it could be considered as niche in the context of the province and given the electricity supply?

A. There are many other utilities that have summer peaking in Ontario as well, not just Toronto Hydro.

Q. Could those also constitute other niches?

A. Since I am not very certain what niche is in the dictionary definition, I don't want to get very deep into this.

A summer peaking utility is different. It's got special characteristics to it that can take advantage of photovoltaics, if that's what you are getting at, yes.

Q. Now, the project at Sunnybrook Hospital, what kind of benefits do you see flowing from that project for Ontario Hydro?

A. A better understanding of how a large photovoltaic facility would operate in offsetting the summer peak load at a large institution. We would also learn how to work with large institutions, the

administrators, the maintenance staff, we will see to what extent the equipment reliability and performance expectations will pan out. Those are the kinds of expectations we have for a project of that nature.

Q. What benefits would you see for Toronto Hydro from a project like this one?

A. I guess they will again better understanding their impact on their distribution system, how it interacts with the existing facilities, whether the power quality is acceptable, harmonics, things of that nature are acceptable to the system or not.

Q. Are they a partner in this project?

A. I don't know.

Q. And for Ontario Hydro customers or Toronto Hydro customers, what benefits would you see flowing to them as a result of a project like this?

A. Well, I guess for their utility, meaning Ontario Hydro and for their government and for the province, to explore more options that have environmental benefits, I think is something that our customers expect us to be doing.

Q. Now, the photovoltaics, as I understand it, from 344 are very flexible in terms of location and size, they can be scaled to suit need very

easily and they can located in many areas very easily; is that correct?

A. Provided the orientation towards the sun is available, yes.

Q. Has Ontario Hydro done any analysis to come to an understanding of the role that photovoltaics could play, for example, in meeting distribution imbalances within a city like Toronto through a strategic location?

A. Not in that detail to my knowledge, no.

Q. Is there something that --

A. Again, because we don't know the strategic locations that Toronto Hydro would benefit from, system support or location or generation, this data and these operation problems are not familiar to Ontario Hydro. They are specific to Toronto Hydro.

Q. Do you think it would be of benefit to Ontario Hydro to explore this area with a municipal utility such as Toronto given that distribution upgrades are extremely expensive and perhaps could be met in another way such as strategic location of photovoltaic arrays to reduce peak?

A. I think options like that are a benefit to the customer eventually, whether there are a

benefit to Ontario Hydro or Toronto Hydro. I think if there are potential applications of reducing distribution expansion by various methods, they will be of great benefit to the customer.

Q. Are you aware of any plans by Ontario Hydro to look into this particular area?

A. I'm not aware of any, no.

Q. Is it possible that you could check and perhaps confirm yes or no at this point?

A. I will get back to you if the answer is --

THE CHAIRMAN: If they were any such plans would you know about them?

MR. SHALABY: There is a good chance I would, yes.

MR. MORAN: I should have asked that question.

Q. If you don't know about it is it likely that there aren't any such plans then?

A. If it's any different I will get back to you, how is that.

Q. I don't know in we need to make that into an undertaking, Mr. Chairman.

Now, I would like to draw your attention to Exhibit 74. I put some excerpts in the document

just for convenience of reference. You may wish to use the original exhibit.

[4:03 p.m.]

And on the first page there is item 2.1.1 which falls under "General Demand/Supply Principles", and it states:

> Ontario Hydro will aim to develop a mix of demand and supply options that provides electricity service to customers at low total customer cost.

I would like to draw to your attention on the third page of the excerpt item 5.6.1, which falls under the category of "Ontario Hydro Supply", and it reads:

> Ontario Hydro will continue to investigate the technical and economic feasibility of alternative generation sources, particularly those that use renewable and Ontario resources.

Keeping in mind the original questions I asked you about Ontario Hydro's research program for photovoltaics and your answer to that, if we assume that you established 1 per cent of your existing capacity in the form of photovoltaics, then based on the range of costs and benefits that you have set out in Exhibit 344 for the two photovoltaic scenarios, the

two kilowatt and the 100 kilowatt scenario, would you be able to calculate the actual impact of such a scenario on actual rates as of today at some point in the form of an undertaking?

A. Well, we would be able to. We have shown that we can produce mountains of paper and reams of numbers. That's not the question. Would it be helpful is perhaps the question to ask.

Q. I ask for the undertaking in the context there is a strategic consideration set out in the DSPS that talks about total customer cost as opposed to individual cost of individual items--

A. Yes.

Q. --and also one that points to continuing investigation or research, to use a different word.

A. Yes, and we can get a measure of impact on total customer cost by the cost/benefit ratios that we have calculated, for example. We don't need to go to impact on rates and the financial picture...

I say that we have methods of getting a first cut at whether this is lowering or not lowering the total customer cost.

Q. I am asking you to assume 1 per cent

of the existing capacity in the form of photovoltaic at current costs as you have estimated, and if 1 per cent is in the form of photovoltaics what is the actual impact on rates. Not the cost/benefit ratio, but the actual impact that you would see on the rates themselves?

A. Again, we would have to make assumptions as to how quickly that 1 per cent comes in.

Q. Let's assume it exists right now.

A. One per cent is 250 megawatts--

Q. Right.

A. --at $8,000 a megawatt. Let me count my zeros here correctly. That's $8,000 a kilowatt. Something like $2 billion. Am I right?

Q. You have the calculator.

A. I have the calculator, but, again, my mind closes down after 2:30.

Yes, by my first cut calculations of my photovoltaic calculator it is about 2 billion bucks.

Now, that is an awful lot of capital. If that enters rate base in one year that is sort of similar to a Darlington unit coming into rate base or something like that.

Q. One of the assumptions that you make in here, though, is that would be costed over a period

of thirty years based on the lifespan.

A. Yes, you depreciate that --

Q. So using that as a basis --

A. That is what I am saying. It would be equivalent to, say, a Darlington unit coming into service, which has something like 3, 4, 5 per cent impact on rates.

So I am trying to avoid doing a rate impact case, and if I can help you by getting something close to it that we have looked at and are familiar with if that satisfies the information request you have I would prefer to deal with it that way.

So we are looking at, say, 3, 4 per cent impact on rates if we amortize a facility like that over 30 or 40 years in very rough numbers.

Q. Is that a 3 or 4 per cent increase?

A. Yes.

Q. And the current rates, cents per kilowatthour is what?

A. Five or six, somewhere in there.

Q. Cents?

A. Yes.

Q. And 5 per cent of that would be approximately what?

A. A quarter of a cent.

Q. A quarter of a cent?

Now, on the basis of that impact, a quarter of a cent - and it is a very rough calculation, I agree with you on that - based on that and given that you are interested in finding out how these things perform in Ontario and to do research, at least if one looks at the demand/supply plan strategy considerations, wouldn't a scenario like that give you an opportunity to do real-time research in the Ontario context as opposed to what you are currently doing, which is a literature research in other areas and a few demonstration projects?

A. I don't know whether many people would agree with you that a $2 billion investment can be tucked neatly under the heading of "research". I think this is a massive implementation of -- this would be the very largest demonstration program or program on photovoltaics anywhere in the world.

We heard this morning that the entire installed world capacity is somewhere in the 200 megawatt range, so for Ontario Hydro to double the world capacity in its own territory over a short period of time is not really a research program, and I don't accept that you need to go that large or that massive to understand the nature of the technology and how it

performs.

Q. Well, how large and how massive do you think you would need to go then to get that kind of --

A. I think the demonstration projects that we are building right now and we have under way right now give us the data and the information that we require for the decisions that we need: the 100 kilowatts at Sunnybrook, the 10 kilowatts at Big Trout Lake, the Kortright, the Ontario Place, and so on.

Q. Are you able to tell us how much research and development money and time and effort and personhours has been put into nuclear research and design just for comparison purposes?

A. We dealt with that as well. I am starting to believe that nobody reads the transcripts. Everybody says they do, but I don't think they do.

Q. I will admit I haven't had a chance to read all of them...

A. We have dealt with that. It is several times, maybe 20, 30 times the renewable. The interrogatories that were mentioned as well show that something like 30 per cent of the Research Division budget, which is about $80 million, the budget is 30 per cent of that --

I know I accepted the fact that we do a lot more research in nuclear than we do on solar photovoltaics, and I also gave the reasons for that.

Q. You indicate in Exhibit 344 that the cost estimates are based largely on estimates you get from manufacturers and then judgments are applied to them by Ontario Hydro and you come up with a cost estimate.

I am just curious about what kind of judgments you actually apply to the estimates you get from manufacturers of photovoltaics.

A. For photovoltaics we have had to make several purchases over the last several years. The judgments would be in the nature of what the more reliable supplies would be, for example. We would probably discount supplies that we have bought that were not reliable.

We will make judgments as to the larger scale facility. For example, we will give a different price for a 100 kilowatt facility than for a 2 kilowatt facility. Those are the kinds of judgment of quantity purchase, for example. What the discounts would be in that category.

Q. Have you, as Ontario Hydro, tried to solicit proposals from, for example, the NUG industry

to determine if these estimates and judgments are in fact workable and valid and accurate?

A. Well, I think by publishing these results in an exhibit like 344 we have solicited a lot of discussion and comments from all the Intervenors in this hearing, and the document is on the table for people to look at.

Q. I guess I am interested more in outside the context of this hearing. I will draw your attention to demand/supply planning strategy element 4.1.3, which is on the second page:

> Ontario Hydro will regularly communicate the need to non-utility generation -- to potential non-utility generators, request proposals to contribute to that need, and negotiate detailed terms and conditions with suppliers whose proposals have potential to satisfactorily meet the need.

That is what is driving the question I just asked. I mean, have you actually tried to solicit proposals for photovoltaics from potential non-utility generators to determine if your cost estimates and judgments are in fact accurate?

A. The answer to the first part of the

question, not my knowledge. We don't solicit proposals for a particular technology. When we solicit proposals we solicit proposals for electricity, however made. That is my understanding.

My understanding as well is that the NUG division - and Mr. Brown testified in Panel 5 - has a program on alternative energy technologies, and perhaps one of the objectives of that program is to solicit particular alternative energy technology proposals from the NUG industry. But to my knowledge that solicitation has not taken place yet.

Q. Would you agree that that kind of solicitation might be useful in determining the accuracy of Ontario Hydro's costing estimates and judgments?

A. It might be useful in getting the industry to provide photovoltaic generation of electricity, but typically when the industry does that we don't have access to what their costs are, how they put the packages together, and how much they paid for their products.

Q. Yes.

A. Typically, we don't know what their costs are.

Q. But presumably they are going to ask

Ontario Hydro to pay them something in return for the supply?

A. We will pay them for the electricity, but typically, we don't know the details of their projects, what the financing structures are, and what the prices for the products that they bought are, what the labour is, what the profit margin is. Typically, we don't have access to all that information.

Q. Presumably --

A. So I don't know whether it will confirm our prices or not. I'm not sure whether it will or will not.

Q. Presumably they will make proposals that they believe they can make money on though, and presumably if Ontario Hydro is paying them some money for that you are able to compare what you are paying to your own cost estimates?

A. If we pay somebody "X" dollars per megawatthour we can make inferences as to typically what kind of return they require and what the costs for their equipment will be, yes.

Q. And to your knowledge, Ontario Hydro hasn't actually done that?

A. Not to my knowledge.

Q. And you would probably know about it

if they had?

A. Yes.

Q. In 344 again you have referred to photovoltaics as being non-dispatchable given the intermittent nature of their operation because of the intermittent nature of sunlight, and you also indicate that they do receive a partial credit because there is a match between sunshine and air conditioning needs, for example.

I am just wondering if Ontario Hydro has done any analysis to determine if solar in conjunction with -- in the context of a widely dispersed system would change the actual credit that you give. I believe it is 20 per cent if I remember correctly.

A. The theoretical answer to that is yes, credit goes up, if you have photovoltaic facilities, for example, in Thunder Bay, in Sudbury, in Toronto and Hamilton, and Ottawa and Kitchener, various geographic locations. It is less likely that all those locations would be cloudy all at once, for example, or for any extended period of time. So theoretically the capacity credit goes up with geographical dispersion.

Actually, your own Dr. Tony Rottenham, his own thesis at the Imperial College in London discussed that effect. His thesis was on dispersed

generation and the impact of geographical dispersion on the capacity credit. One of the aspects he studied was that.

Q. I take it your answer would be much the same in the context of wind generation as well?

A. Actually, his thesis was on wind, and I am taking it into photovoltaics.

Q. And given that you --

A. Tell Tony that I still remember his thesis.

Q. I will pass that along to him.

Given that you started your answer off by saying "theoretically", I assume embedded in that is that such an analysis hasn't actually been done by Ontario Hydro.

A. No, theoretically as opposed to people have actually tried it and put it in different locations and have made measurements and so on. It is simulated and calculated rather than actually built up and measured. That is what I mean.

Q. Moving on, then, again in 344 you have assumed a 30 year life for photovoltaics as part of the basis for coming up with cost estimates, and I would like to turn your attention to page 30 of Exhibit 344.

At 1.7 on the right-hand column on that page under "Operational Considerations", paragraph .1:

Photovoltaic modules require little maintenance once installed. They require no fueling and there are no moving parts. Maintenance for one of the larger installations, the 1 megawatt plant at Hesperia, California consisted of once weekly site visits by an engineer. Otherwise, the plant operated unattended.

Given that, I am just wondering what goes into the assumption that a photovoltaic has a 30 year lifespan if there are no moving parts, very little maintenance involved, and, in fact, the cost estimates also reflect that, but what else goes into the decision that would indicate a 30 year lifespan would be appropriate for the purposes of costing?

A. There occurs deterioration in the efficiency and performance of the photovoltaic cells. They have welds and solders, and they have chemicals. You know, it is chemical cell that has properties that deteriorate with time. Efficiency and the performance deteriorate with time. The soldering of the equipment deteriorates with time.

Typically, facilities have not lasted

even five or six years. Most facilities have deteriorated considerably in that time period. So I think 30 is assuming a lot of improvement in various parts of the facility.

And again, we could be into replacement of components where the inverter, for example, can be replaced more frequently, the panels less frequently, the glass even less frequently than that. So again, the single lifetime for a complex plant like that is a simplifying assumption. In reality, things will get changed at different intervals, and it could become technologically obsolete by the arrival of a much more efficient cell, for example.

Q. Would you agree that a lot of those effects are local in nature, environmental in nature? In other words, they might vary from location to location; it might be different in Ontario than it is in California, for example?

A. They might be, yes.

Q. This might be a useful area for research in Ontario so that we could get a better understanding of the Ontario picture; right?

A. It could be, yes.

Q. I assume you will agree that the life that you choose has a direct impact on the cost/benefit

ratios that you come up with?

A. Yes, it does, and we alerted others to the sensitivity analysis that we have done in the report for that.

Q. Okay. One thing in the solar chapter that I don't see is any discussion of the possible role that could be played by passive solar water heating as a method of displacing electric water heating. I am just wondering if there is a particular reason for not putting it into this discussion.

A. The focus of this report was on technologies that generate electricity, and we spoke to some degree in Panel 4 about solar water heaters. So it is a matter of scoping this report to look at technologies that can fulfill major supply requirements rather than demand reduction.

Q. I won't pursue that any further than I will check back in the transcript and we may have additional questions tomorrow. So we will move on.

A. Okay.

Q. I would like to move now to wind generation, and again in Exhibit 344 it is indicated that wind technology is also well-established.

[4:25 p.m.]

You indicated that wind assessment is

based on airport readings and that more work was required.

My question is: Does Ontario Hydro have any immediate plans at this point to start that work that you are aware of?

A. Work related to what specifically?

Q. The more site specific studies that you indicated in your direct evidence that would be required to properly assess the wind resource in Ontario?

A. I also gave the evidence that we are participating, sponsoring some of the work to assess the resource on the Bruce Peninsula, or in the Bruce area, our generating station area.

Q. Are you aware of any plans to do a comprehensive evaluation of wind resources in Ontario, across Ontario?

A. I don't think Hydro has plans like that, no.

Q. But you will agree that that knowledge is essential to a proper assessment of the wind resource; right?

A. It is.

Q. Actually, one of the questions often raised is: What if you do a comprehensive survey of

wind resources, what do you do with that information? Who has access to it? Will it cause land speculation? It could cause problems.

To take the analogy, what if the Ontario government goes and finds where all the gold is in Ontario, what do you do with that information?

Q. Are you suggesting that ignorance is bliss perhaps?

A. No, I am not. I am suggesting that people who are serious about developing the wind resource will make the effort to go to areas and make the determinations and the measurements necessary to decide whether the investment is worthwhile or not. Just a massive survey of Ontario for wind sites is a fairly costly exercise.

Q. But you are in a position to focus that survey, aren't you? I mean, you have some preliminary readings that would guide you on where the best places to look would be.

A. So does everybody else. We have as much data as everybody else on that.

Q. And you are the largest utility in North America and much larger, for example, than a small entrepreneur who might be interested in taking advantage of that information but perhaps can't afford

to go out and gather it.

A. We are larger than a small entrepreneur, yes.

Q. You are certainly in a much better position to gather that information.

A. I just want to keep the interest of my fellow panelists, the bored-again panelists.

Can you distribute the questions on different subjects? They beat me up when we get back there for speaking too long. [Laughter]

Q. You will agree that your analysis of the wind resource based on the limited information you have at this point suggests that it's much more economical than the photovoltaic option?

A. Wind is much economic, closer to economic break-even than photovoltaics, yes.

Q. And a proper assessment of the wind resource might actually indicate that it could be even more economic than your current estimates might suggest?

A. Yes.

Q. And if you did the information-gathering it might be something that you might take advantage of as opposed to other people because it might be so economic; right?

A. Yes.

Q. And in so doing you would be able to defer perhaps other forms of major supply if it turned out to be worthwhile?

A. That is correct.

Q. Now, I would like to go through the same process as we did for the photovoltaic option. Let's assume that 1 per cent of existing capacity is in the form of wind generation. What kind of impact on current rates could we expect, ballpark figure again?

A. It would be much smaller than photovoltaic because the cost of wind turbines is considerably less than the cost of photovoltaics.

Q. In other words, it would be much smaller than a quarter of a cent which is what you roughly estimate it for the --

A. Yes.

Q. And if you had 1 per cent of your supply in the form of wind, you would be in a position to do ongoing research in the Ontario context?

A. Do a lot more than just research, yes. One per cent will put us right up there with the largest utilities using wind in the world.

Q. And if we look at the research that you might be able to do in that context, both in wind

and in the photovoltaic context, this very well could have an accelerating effect on the sliding price that you have indicated is happening anyway?

A. It will have an effect. I'm not sure how much of an effect on a world market would Ontario Hydro's 1 per cent would do, I'm not sure. But it will have an effect nonetheless, yes.

Q. And in the Ontario context, it might become more economical for Ontario earlier rather than later if you do the research yourself as opposed to waiting for a breakthrough to happen somewhere else; right?

A. I don't know that. Again, there are advantages for, as I say, joining other teams in research or waiting for others to do the leg work.

Q. I would like to move on to fuel cells now.

As I understand Exhibit 344 on this topic, fuel cells are potentially a very favourable technology; isn't that correct?

A. Very?

Q. Very favourable technology, very promising technology?

A. It has a lot of benefits that were discussed in the report, yes.

Q. Now, for practical purposes, again looking at Exhibit 344, this option is essentially a fossil fuel option because for practical purposes you are relying on natural gas as the fuel; right?

A. That's correct.

Q. But you get higher efficiency from this use of natural gas, as opposed to a CTU use; isn't that correct?

A. Most of the advanced fuel cells will be higher efficiency than the CTUs, yes.

Q. And the air emissions would actually be lower than a CTU as well?

A. That's correct.

Q. Now, you indicate in 344 that presently you don't believe the fuel cell option to be economic if it's used simply for the purposes of producing electricity.

A. Yes, the cost/benefit ratio exceeds one.

Q. Yes. In a cogeneration setting, however, it could be very well economical; right?

A. It could come closer to being economic, yes.

Q. And again, keeping in mind the Demand/Supply Plan Strategy, 4.1.3, where you indicate

that you will regularly communicate with the non-utility generation people for potential opportunities, are you aware of any solicitations Ontario Hydro has made for fuel cell cogeneration proposals?

A. Not on a wide scale, no.

We have a fuel cell working group looking at the purchase of different types of fuel cells for a demonstration purpose in association with people like the gas companies, for example, and some of the technology manufacturers here in Ontario, but it will not fit under the label of solicitation, open solicitation in the marketplace.

Q. So at this point you don't have any real way of knowing if your estimates and judgments are accurate because they haven't been tested in the marketplace? You haven't received any proposals?

A. Well, they are based on manufacturers' information and on the research organization estimates. So again, not the only way of validating estimates will be to put out the solicitation to the non-utility industry; there are other ways of doing that.

Q. Very often when I see manufacturers' estimates I often see in brackets 'retailer may sell

for less'. Doesn't that suggest that possibly in the marketplace it might very well be economic? You might get economic proposals?

A. There is also the phenomenon of low-balling an estimate to spark your interest and once your are interested they hook you twice for what they told you it would cost. So I think on balance you have got to be careful about what the estimate you are getting is.

That is a value of participating with other utilities and knowing the products, to be a knowledgeable buyer and a knowledgeable information processor, Hydro wants to know whether the information is valid or not, what to believe and what not to believe.

Q. Fuel cells, unlike photovoltaics and wind generators, are suitable for base load; isn't that correct?

A. Photovoltaics and?

Q. Fuel cells, unlike photovoltaics and --

A. Yes. I'm sorry. You are correct.

Q. And in fact, they are extremely good at following the load shape; aren't they?

A. I think some are more load-

following -- have more load-following capability than others. Some of the higher temperature ones are less capable of following load than others. But in general they can be made to follow load, yes.

Q. And if we turn to the demand/supply planning strategy, item 1.7, which is on the front page, you see there:

> The primary criteria (which must be met) for evaluating and developing recommended plans are... And then there is a list. ...customer satisfaction, reliability, standards, safety requirements and standards, environmental requirements and standards, low cost of electricity service, social acceptance, technical soundness and flexibility.

Would it be fair to say that fuel cells, particularly in the -- well, fuel cells generally speaking would meet all of those criteria except for perhaps the cost criterion?

A. Cost and I think the reliability and technical soundness have not been established. They have been promised at this stage but they are yet to be established. The product is not commercially available. Some of the demonstration units have worked

well, some have not.

So, if the technology lives up to its promises, yes, all of these will be satisfied with the exception of low cost.

Q. The chapter on fuel cells suggests that at least phosphoric acid fuel cells are commercially available.

A. They are available but my information is that not all the units that have been available and tested by utilities have met all of these criteria with flying colours.

Some facilities, like the one in New York City, for example, the 4.8 megawatt unit in New York City had tremendous problems with their reformer and with the various problems that prevented it from working for any length of time. It really didn't perform anywhere near the expectation that it was supposed to perform at.

Q. What about the National Research Council demonstration model, the 40 kilowatthour one, how did it perform? How has it been performing?

A. Again, it's being modified continually by the utilities that host it. Hydro is now modifying it, to do things of different things with it. I don't have an accurate or complete record of how

it's performing.

All I am saying, it's not an established technology, that you turn the button and it starts up, and so on. It takes, for example, several hours for the reformer to warm up, and if you get any interruption it goes down and has got to warm up again for two or three days before the reformer is up to operating temperature. You have to get rid of all kinds of air and gases in it before it starts reforming and so on. You have got to handle it with a lot of love and care to get it to work.

Q. To your knowledge do you know if Ontario Hydro is doing any analysis of what kind of use could be made of fuel cells particularly in the context of balancing distribution imbalances in large cities such as Toronto as an alternative to upgrading distribution lines?

A. Well, I guess my answer to photovoltaics would apply as well. But upgrading of distribution in urban areas is the business of municipal utilities, and the information on it, the nature of the problems, the alternative solutions is not something that we are very familiar with and don't get into very much.

But you may recall that Mr. Shepherd

brought up the issue that the APPA, the American Public Power Association, which is equivalent to a municipal utility association, are interested in fuel cells. So typically, operators of distribution systems are taking interest in fuel cells because it could address a lot of their own problems.

Q. If some of the technical problems that you have indicated are resolved, would it be fair to say that fuel cells in fact would be even better than photovoltaics for this kind of work given that location is even more flexible for the fuel cell option than it is for the photovoltaic option?

A. It certainly offers a more continuous operation, more than photovoltaics. You can probably put a larger sized facility in an enclosed place than on rooftops. So in terms of energy density, it's a higher density, it can operate for longer periods of time. On the other hand, it has considerations to do with fuel delivery and emissions and chemicals, handling chemicals and things of that nature. So it's got advantages; it's also got some disadvantages.

Q. Are you able to say if there would be an equivalent possibility for the larger upgrades that were discussed in the transmission panel as a possibility for resolving some of the bottlenecks that

exist in the bulk electrical system?

A. By the use of fuel cells?

Q. Yes.

A. My understanding of transmission, the transmission requirements, and Panel 7 discussed that to a great length, transmission is really required for many, many purposes. And I think the location of a fuel cell in certain places can perhaps address some of those reasons or some of the requirements for transmission, but often not all the requirements.

So I think perhaps it could delay the need for transmission or reduce the size, but the need for transmission usually is driven by many, many factors, and I don't think fuel cells can address all of those factors.

Q. I would like to turn now to biomass.

Again, in Exhibit 344 Ontario Hydro refers to figures from British Columbia which estimate the quantity of wood waste that is produced annually, and it also indicates that British Columbia is looking at that as a resource and is looking at methods of better using it, particularly for the purposes of generating electricity.

[4:40 p.m.]

Do you know if Ontario Hydro has any

equivalent figures for this province?

A. We have provided estimates of wood waste availability. Panel 5 went into detail of the source of those estimates - from Ministry of Natural Resources, for example. Is that the kind of estimates you are asking about?

Q. Yes. I am just curious about those figures factor in the analysis in 344 since there is no mention of them in 344.

A. I think 344 was discussing to some extent the plantation option.

Q. It discussed both the wood waste and the plantation option.

MR. DAWSON: A. I think we did talk about wood waste availability in Ontario in 344. We said there was currently something like 200 megawatts worth of wood waste, of which about 100 megawatts is currently being used, and we estimated -- in the back we have an estimate of the amount of generation in the future from wood waste.

Q. Yes. I understood there was an estimate of generation, but I didn't see any estimate of the actual resource that is available. I understood that to be simply --

A. There isn't a detailed breakdown of

the resource. There is a statement that says something to the effect that there is about 200 megawatts' worth of wood waste available in Ontario, and I think Mr. Shalaby said that estimate came from Ministry of Natural Resources, he thought.

MR. SHALABY: A. To the best of my knowledge, it was the Ministry of Natural Resources.

Q. It was perhaps a misunderstanding on my part. I thought that was an estimate of what exists in Ontario in the form of actual generating plants as opposed to a reflection of the size of the resource available.

A. No, I think we characterized the resource in terms of the waste available, the potential for plantations, and plantations can be made to any size and measure, and described the technology that can use that resource, whether it is waste or plantation.

MR. MORAN: Now, Mr. Chairman, I am wondering whether this might be an appropriate time for us to stop.

THE CHAIRMAN: Sure.

MR. MORAN: Thank you very much.

THE CHAIRMAN: We will adjourn now until tomorrow morning at ten o'clock.

THE REGISTRAR: This hearing will adjourn

until tomorrow morning at ten o'clock.

---Whereupon the hearing was adjourned at 4:45 p.m. to be reconvened at ten o'clock on Wednesday, March 4th, 1992.

JAS/RR